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E-Teaching Administrative System

Helsinki Metropolia University of Applied Sciences

Bachelor of Engineering

Media Engineering

Bachelor's Thesis

03.03.2013

Helsinki Metropolia University of Applied Sciences

Author(s) Title Number of Pages Date	Simon Boahen E-Teaching Administrative System 56 pages 3 March 2013
Degree	Bachelor of Engineering
Degree Programme	Media Engineering
Specialisation option	Audiovisual and Printing Technology
Instructor(s)	Kari Aaltonen, Principal Lecturer

The aim of the project was to develop a web application that converts the traditional method of studying and cooking which was done physically in the presence of students into an electronic form that will enhance self-studies. The goal of the project owner was have a user friendly interface of a web application that emulates the traditional teaching method but requires little work to make teaching materials available to the end users.

To be able to reach the target of the owner, various content management system platforms that organize all data and allow easy creation of new content and update of already existing ones were explored. This forms the base of which the project application is built. The choice of the content management platform was based first on my previous knowledge and then the preference of the owner. To gain full control of the system, a user must have the credentials to log in.

The thesis focuses on how a login administrator can easily create new cooking recipe into the database and display them in the front page, delete and update content, and for all other users to add recipe ingredients to a shopping cart.

E-teaching services have seen growth over the years which cannot be over-looked and as long as technology exists, the growth will continue. Various processes were followed and the outcome of the end product was satisfactory to the project owner.

Keywords	content management system, e-teaching, e-learning, multimedia,

Contents

Terms and Abbreviations

Mock-up	A visualized model of a design.
Bug	Error, flaw or failure in a computer software or program.
CSS	*Cascading Stylesheet*. The language used to describe the looks of a web page
CMS	A computer program that allows editing, publishing and modifying content from a central system.
PDF	A format that makes forms, documents, graphics etc. looks the same as if it was printed and can contain clickable links.
CD	Compact Disc, optimal disc use to store digital data.
DVD Rom	A read-only compact disc that designed to store a minimum data size of 4.7 gigabytes.
Database	A collection of organized data for easy accessibility.
Multimedia	Combination of different kind of content; text, video, audio or images
URL	A web address that is used as a reference to a resource.
Operating System	Software that creates platform to run an application on a computer
Plugin	Components that adds extra functions to an application.
HTML	*Hypertext Markup Language. Used to write web pages.*
PHP	Server-side programming language for web development.
UML	A modeling language to design visual mock-up.
Scrum	Interactive framework for managing software projects.
CSV	Stores tabular data in plain-text form.
SEO	Used to enhance the visibility of web pages in search engines.

1 Introduction

The traditional classroom learning method has been practiced for many years since the existence of education. It involves the presence of a teacher and student or students in a physically existing environment or a classroom. Students have the opportunity to interact with each other, work together on projects as a group and do presentations to improve their language skills and confidence in public talk. Other ways of learning emerged along the line and the short comings of the old method faced some criticisms that allowed many to adapt fully to other methods or combine both. One of such methods is the electronic way of learning.

The electronic learning method is the opposite of the former, studies are conducted using virtual environment. Access to teaching materials has no limit as long as there is an internet connection. Contributions are made by typing or opening a muted microphone. In the case of web applications, contents are written in text or in portable document format (PDF) and made available to the user.

E-teaching involves using electronic learning method to reach out to students through internet and web applications. Internet educational tools help to enhance the delivery of teaching. The teacher prepares educational materials in any format that fits and uploads it on an internet server for students to access. Submission and assessment of assignments are done through available wikis or emails. Lessons can either be live or accessed later. For live online lessons, attendance of students is checked by the presence of their respective avatars or login names.

The client of this thesis project uses the traditional practices in teaching students various recipes and the process with which it can be prepared. Hard copies of recipe instructions and needed ingredients are printed and shared among students in each cooking lesson. The main goal of the thesis is to develop a web application that converts the traditional method of studying and cooking into an electronic form. It will allow the teacher to easily put content into the database and students can access them at any given time. The content may include texts, images and videos. Users will with just a click select ingredients of recipes into a shopping cart or be able to print multiple cooking instructions by selecting them. The application will be available to anyone connected to the internet.

2 E-Learning

2.1 General roadmap

E-learning is a modern way of having access to learning and teaching material or information at any given time and place with the use of available technology. This method is mostly done on the internet or intranet. It is a good way to cut down the use of printed papers which has generated an issue on how to recycle after its use. The roadmap is putting everything in the correct order to function as planned.

E-learning is seen by many educationists as cost-effective tool that is designed once and used as many times as possible. In the case of this particular project, it eliminates the cost of printing and photocopying and saves a lot of time in the process. This is the best way to get the participation of wide range of people.

Many have welcomed the idea as an educational tool to reach out to many students who for some reason are not able to be physically present in a classroom. This can also be called long distance learning and there are unlimited methods on the use of electronic systems. [1, 39]

In the process of its establishment to take over the place of physical content, there should be a strategy from the planning to implementation stages. One thing to include in the planning stage is to identify the various users of the technology and notify the kind of physical content accessible to them and how that content can be accessed. The two main users for this project application are the client and students of the cooking class. It was noted that the only way students get access to cooking materials were printed copies from the client.

In the next phase along the roadmap, a design was first made using use cases which gave a broad idea on what the user would want the finished application to operate. This was sent to and accepted by the user and a second design was made using mock-ups which highlighted how content would be displayed and accessed in the application and also accepted by the client. At this stage it was agreed that everyone with access to internet can read and use the content provided but only the client who is also the super administrator will have the administrative right to put and delete content from the site.

Before using any tool to develop the e-learning platform, it is necessary to think of the end user and what kind of means they have to access the end delivery of the electronic format. Some of these formats include internet, CD and DVD ROM. Different computers have different operating systems, and therefore it is good to find out what operating system the users have so that the end design will suit all computer platforms and browsers [2, 12].

Figure 1 is a roadmap of the process involved in reaching out to customers in electronic deliverables. In all there seven given stages in the conversion line until the end user start to assess technology behind the delivery.

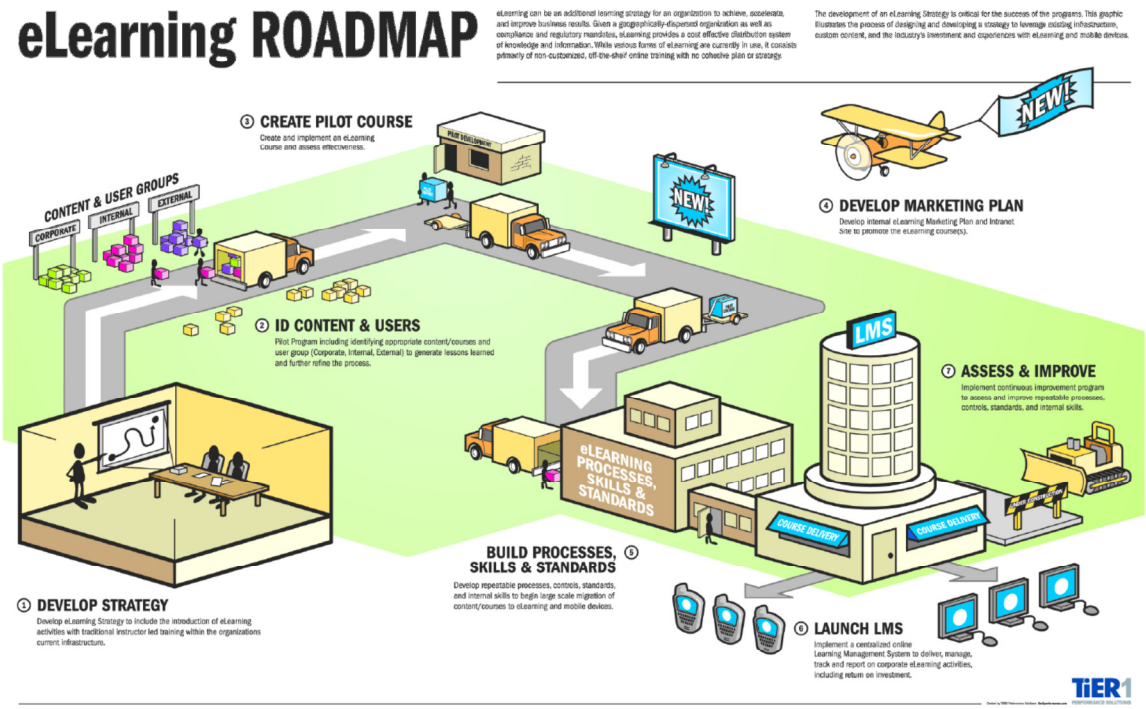

Figure 1: E-learning strategy [8, 4]

In the first step in figure 14, is how to develop a plan in the introduction and organizing content to be used in the process. The next step is a pilot program that includes identifying the appropriate user group and the content they use. It goes on to create a course, make a marking plan, distribute in a different format and work on improving the assessment level of the end product.

Online content can be viewed from anywhere and the cooking includes a multinational recipe allowing many to learn cooking food from different part of the world using native ingredients. Included in the provided internet content are the two major languages used in the Finland where the client in based (Finnish and Swedish) and one international language (English). The content can easily be translated by choosing a preferred language [2, 12]. The project is intended to make a mobile version which can be accessed with smart phones connected to the internet.

It was noted that the client uses Excel in writing number of recipe ingredients to be purchase in the shops for the course. This seem very important in the old method of cooking and in order not to eliminate this purpose in the electronic format, the Excel application was added but in a more flexible way. Needed recipes are selected and with just a simple click it can be printed in Excel form eliminating time taken to physically input all needed content.

The development of the application followed the design stage where all physical content are entered electronically to suit the design. This was the first pilot project that was tested and found to be working right for its purpose. A later improvement was made and all content are kept and can be accessed from a central storage system on an internet server.

In order to make teaching and learning easier and effective, the user interface was made as easy as possible; arrangement of pre-training was agreed after the end of the project to take the client through the navigations and management of all the content in the database.

The initial time spent in converting all the physical content of recipes into an electronic content was much but it was done once, and modification to any of the content becomes easy afterwards. This can be a disadvantage; also another challenge that faces electronic content is the fast rate at which technology is changing: it has to be updated to meet the standard of new technologies. Since this application is a website base web application, it does not really need to be updated because no matter what kind of content management version is used to design the website, it can always be displayed in any web browser.

The most necessary thing in making an online course effective is unlimited access to the internet. The whole content will be stored in a central system on a server so with access to the internet anyone make use of the available recipes. Also a content management system that is able to manage as many and any format of content is needed. This is also able to allow many administrators to create and modify all multimedia content of each recipe.

The users have basic knowledge in computing so changing the old method of cooking into a new and a flexible method will not be a problem. Using this method also means that everyone should have a computer to enhance the learning. It will be easier to access this from home if the user only has a desktop computer. Knowing everything about what the user wants saves enough time and work at a later time.

There are many forms by which content distribution can be made. Some of these include using virtual classrooms like second life environment where people are able to go to the extent of buying virtual lands to build and hold business meetings. There are also online presentations some of which can be made with already existing technology such as Skype.

For a compulsory course in a school where participating is obligatory, available tools for checking attendance of students in a live online session can be applied. Names of participants are shown when logged in. When talking is allowed, the microphone can be opened and muted if not needed. Students can login just to be seen but the introduction of a chat for responses is sometimes used.

2.2 E-learning strategies

Strategies adopted in this environment focus more on the needs of the client instead of the tools used in creating the environment. The process of inputting and outputting information to and from an application forms part of the strategic plan [3, 2]. The final delivery should be directed towards the needs of the client, many a times developers try to make the delivery very fancy and at the long run becomes unusable. The purpose of strategizing cuts down unnecessary costs in producing more than is needed.

In this phase, the technology that will be used to design the system has to be taken into account and its future sustainability should carefully be looked at. In the early approach

in developing the technology, selected people can be given the opportunity to test the interface which is the first thing experienced before pressing, clicking or testing any of the functionalities of the technology. It is cost effective and time saving to make modification to the design at this early stage.

Maintaining and updating the content though comes at the later part when the product is been used, should be taken into consideration. Failure to realize that will incur a lot of costs on the provider of the service. Regular checks should be made, in a situation where content are accessible only from the internet and customers are paying for the service. Broken videos and links to external files should be fixed; backing up of files in a separate storage system will be of great help in a situation like this.

To maintain quality on internet based service, a feedback section will be appropriate where users will submit their experience in the use of a software or technology. Improvement of the study method can easily be made to fit the required desires.
Figure 15 shows a performance system of transforming a physical existing content to the end user in a file format that is suitable. It explains four stages necessary to make the process successful and each stage is dependent on the other.

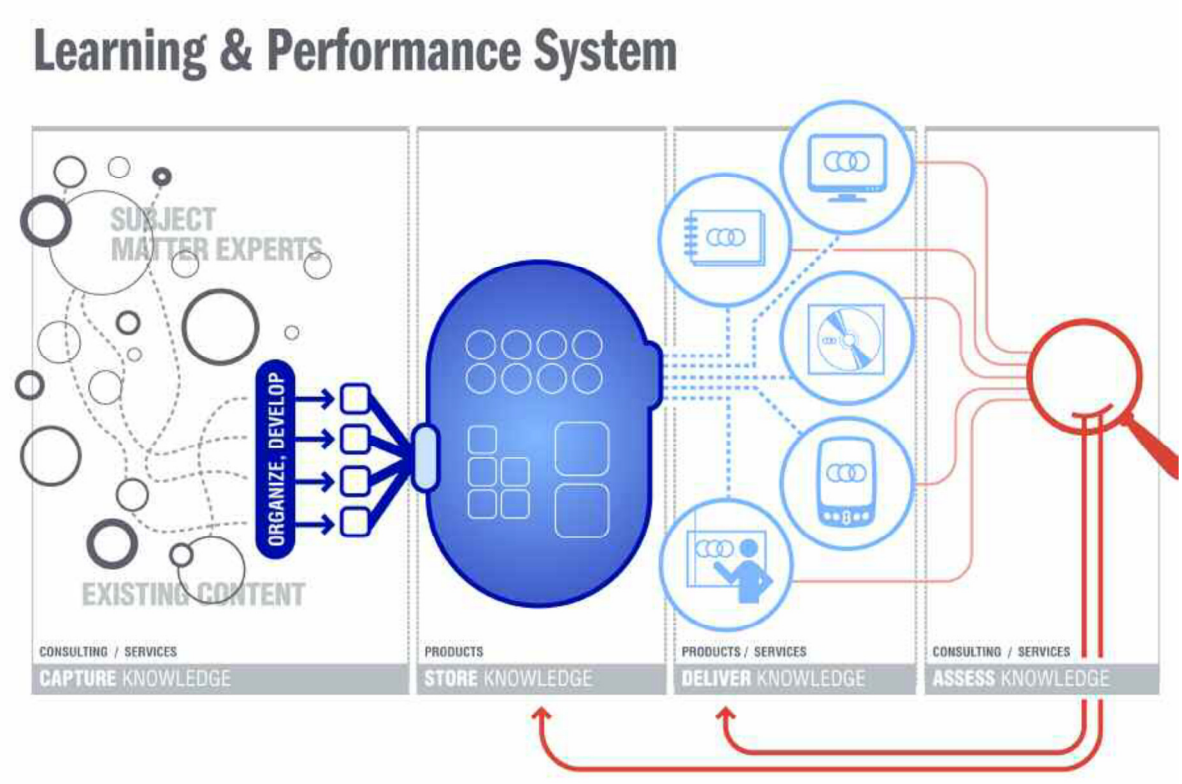

Figure 2: the learning and performance system [3]

As shown in figure 2, a way to strategizing means planning how to organize, develop and store all existing physical content into an electronic storage system. From the storage system, the content can be distributed in various file formats required by the user. The content should be accessible.

2.3 Benefits of E-learning

Students of the cooking class are able to have a self-study of the next class ahead of time and access to information is every time. With this system, students do not necessarily have to be in a physical cooking class but can follow given instructions and watch video tutorial which is one option available to the client to reach out to various customers.

To fulfill the needs of customers, the video should be done or subtitled to suit users of different languages. It reduces infrastructure and travelling costs which in turn saves time. When watching a video tutorial for example, one can always repeat as many times as possible if a step is missed. There are no missing lectures as in a physical classroom and the same content is available all the time unless otherwise updated providing some level of consistency.

It becomes possible for students to skip recipes which are believed to be already known and focus only on the needed and unknown ones. The pace at which lessons are learnt depends on the capacity of each individual and not on the performance of an entire class; no one is left behind. Information is available for restudy in a case where a previous study is forgotten. In the case of video or PDF files, it can be downloaded on a local computer and accessed without the need of internet.

In a class of for example ten students, it takes a longer time to finish demonstrating how to prepare a meal because it becomes harder for everyone to have a closer look at the process of preparation at a given time. Secondly, instead of the old physical method of recipe on paper, it is easier to prepare food looking closely and step by step at a multimedia content.

For live content sharing where other users are only represented by avatars, the shy and the dummy can ask any question without the fear of been ridiculed by others. It

enhances studies and students can contribute freely to discussions without the thought of being wrong in their contribution. The lecture is recorded and available to be re-played for those who are absent and others to refresh their minds on it.

Different user groups can be created and an access level assigned to each group. Groupings are done base on the level of performance of a group or the study and course level of a particular group. Corresponding study materials are attached to each level. It prevents the mixture of higher and lowers level students in the same room. When a course is missed, the recording can be viewed by such a user before joining the next course without distracting the progress of the course.

Some have argued that learning by doing is obviously the best way. For some methods there are lots of interactions between an application and a user making studies more effective and motivating. Interactive applications include game, web design and social media applications and are used by way of clicking, drawing, drag and dropping.

2.4 E-teaching

Teachers go through the challenge of using tools and technology not earlier known or studied and deliver lessons with the use of those tools to students. Time has to be taken to have a firsthand knowledge on how the tools functions and its response tested. The method of teaching could be asynchronous or synchronous environment. Teachers can operate in as many schools as possible; they do not have to be physically present in the classroom.

Synchronous teaching environment takes place in real time where parties at both ends interact with each other through video, audio or a chat conversation. It is often conscious and there should not be any delay in its delivery. In case of a delay a back-up plan is required. The tools are fully controlled by the instructor but students are allowed to contribute by typing or talking.

An asynchronous method allows students to assess teaching materials anytime and from anywhere where access to internet is possible. To share comment or feedback to the course, emails can be used or a forum for the course where students share their opinion and also grade the effectiveness of it. Learners can upload assignments and course projects to this system while awaiting assessment from a tutor.

Both synchronous and asynchronous methods have their own challenges but when the two are used together in e-teaching, it results in a smooth teaching and studying environment. Each method differs from the traditional way of teaching where books and the presence of a teacher are always needed. Unlike traditional methods, instructors do not have to worry if the student capacity is over the available sitting places. Gradually many institutions are adopting e-teaching because of its reusability.

3 Usability

3.1 Effective user experience

Usability is an easy way by which one can navigate through software. It should be able to give job satisfaction in the performance of task, using the designed product [4, 193]. For an effective user experience, the interface should be based on what the software is supposed to do not only on the internal mechanisms by which it was developed. In many times clients are only interested in what it can offer instead of how it was designed [5, 28]. It should be more useful and make life easier for those that work with it. For example when using a fill in form, if the data is not correctly entered, the system asks for re-entry while keeping the already correctly entered data but sometimes everything has to be filled again.

Many software programs have face rejection by top management because of their complexity in usage though their functionality might be the best. Also when visitors of a website find it hard to navigate through the content or are not able execute a task without help; they will not re-visit the site. From end-users' point of view, usability means quality, as well as easy and friendly way of working. When the usage becomes familiar, the focus is now shifted to rather how quick it responds and not necessarily how easy it is to use. The demand of the customer changes from stage to stage and the development process should incorporate such stages.

It should be taken into account what kind of computers are available and also the representation of how content are displayed. In some companies, a representation of all content is graphical and observed on the screen; others can be audio or text. In this project, both images and text with Maiandra font style were implemented. Navigation of the website is through the top menus. Also to avoid the frustration when a clue is not given after not getting the correct results, an information text is provided if, for example, the login credentials are wrong or there is no result of a search item.

The system should be able to give responses and handle internal errors without displaying them on the computer screen. Some error messages are quite technical and only understood by the administrator. Such messages are confusing and should be hidden. If a form is filled and sent, an informative message of the success of the delivered form should be provided or a progress bar in terms of downloading and uploading

of files. Only errors that give helpful information should be allowed to be displayed. [6, 141]

One way of avoiding frustration is to customize the error page that is shown when a wrong link or request is given. This is usually observed when a link is broken, content has been deleted or when a wrong address was copied. The error page which at some point looks a bit intimidating can be customized and include direction as to how to navigate to the home page. Also more informational text and menu selections could be included as well.

Figure 3 shows a customized 404 error page. This page is shown if a requested page is not found. This is due to a broken link or a deleted content.

Figure 3: customized 404 error page.

Instead of the usual red background and many listed reasons why the default error page has appeared, figure 3 shows a friendlier custom page which gives an assurance that the home page of the website can easily be visited by clicking a link already provided below. The colors of the error page match those of the main site.

A well-detailed manual that is written from the viewpoint of the user should be provided to assist in real working life. The documented manual should contain everything from installation to execution. For this project no manual was written but a test case that was provided gives familiarity on how each component functions and what the expected results should be. Training is given to client on how to go about the day to day manipulation of the application. Technical support is also given to the client should there be difficulties in accessing content.

Consistency on all pages makes adaption easier whenever a different page is opened. If page layouts are different from each other, it takes time to figure out how and where to find the information needed. One good practice is to make the final design as close as possible to its prototype. Leaving the site should be allowed without any pop ups. Also the logout tab should be easily located. In case there are registered users, logout tab should be quite visible or positioned in a familiar way. When the application is closed unexpectedly, it should automatically be saved to keep data intact. In case a person is logged in when the page is closed, the system should log them out to prevent their identity and personal information from the next user.

Graphic designers and other parties involved should be engaged throughout the process. This will ensure that their interest is well illustrated from the beginning to avoid later changes to font, layout and graphics after the completion of the whole project. The integration of the customer helps to guide the project team in decisions of the project. There should not be any unwanted feature that does not improve productivity. Today, many websites have links to almost all the social media platforms but if for example a client does not produce any video as content, it is not necessary to add a YouTube icon in the interface.

The software should be able to for example store text information which can be remembered without having to type it again. For a text input, if the first letter of an already entered text is typed, there should be a hint that suggests possible matching words. The log in credentials of the administrator of the recipe can automatically be stored using a tool that is available in all major browsers. It first asks if the user wants to save the password. A prompt to update password is always displayed when there is change in credentials.

Session lifetime should be a bit longer. The system automatically logs out after it has been on hold for the period of time given and everything has to start from scratch again. This is not helpful in an instance where the process of saving a recipe is still underway. The time needed to complete one creation of recipe is relative and varies from one person to another. To avoid this, enough session’s lifetime of twenty (20) minutes has been set in the system. Another way is to give prompt in about two (2) minutes to the end of the lifetime to either extend the session time or save what has been done before the system logs off.

A process should be able to be reversible inside the system or navigate backward using the web browser. Resetting should also be made possible. Full exploration can then

be done without fear of crushing the system by way of giving the wrong information of content. If a mistake is made in the process of work, the system should recover internally and return to a safe mode or give directions as to where and what to do.

Layout and display of content should be or almost the same in all browsers. Content are shown differently on different platforms so a test should be made to cover all the browsers and possible operating systems. Both the latest and earliest versions of operating systems have to be taken into account as well. The speed at which content are loaded should not differ much from each other or take a longer time in loading.

3.2 Setting usability goals

Setting goals serves as a guide in the design process and checks can be made after completion of each stage against the set goals to see if they were met [6, 89]. All parties involved should come together to plan an effective way of setting the goals. The target of the goals should be user centered and channeled through improving the performance of the end product. This could be directed towards given preference or system performance. Designers tend to ignore the real users' thinking although they can as well serve that purpose. It is always not easy for first timers to know every detail of an application.

Goals can be set on how fast a response to a request is received or time taken to complete a task. For this project it was geared towards how fast the client is able to successfully complete one cycle of creating a new recipe to the database. How long it takes depends on the visibility of the provided information on what type of content to be entered at what place. Graphical presentations should not be ambiguous and should be put at right position. In most of the website where login is required to access extra content, there has always been a common place where login and out are placed. Changing these positions will seem as hiding them from site visitors. Instructions for creating a recipe are visible, easy to read and understand.

It was planned that in getting a responds, there should be minimum usage of one key or click and a maximum of two. An example is shown in adding recipe to print cart. The first click adds the food item to the printer and displays another pop-up confirmation for acceptance of the action been made. It is not pleasant to give many mouse clicks before a response to an item is given. The whole process might be forgotten. In cases

where there is no other way except to do it as many time as possible, a well explained and details manual of the process should be available. The manual should only provide the steps needed to a get a task done and not any explanation of an unseen mechanism of how the system gets the task done.

Names of menus should be self-explanatory and not misleading to other content rather than its supposed meaning. To make it simple and easy, this project has the items of six menus and none contains a sub or drop down menu. It gives a clue beforehand as to what happens when it is clicked. To be able to identify which page is been currently viewed the color of the menu item of the selected page fades. The color of labels in the main content area was made to be green to differentiate it from the content.

To be able to keep update and give regular maintenance, a feedback is added to the menu where experiences can be shared of its usage and possible improvements that need to be done on the software. All sent feedbacks are directed directly to the system administrator and they are checked frequently. A confirmation response is returned on the web page anytime a feedback is successfully sent to notify that an electronic mail has been received. If any of the text field is not filled correctly, the particular text field becomes red and can only be delivered if it is fixed.

What developers build and what users see on a web page are entirely different. Users scan through content to see which one catches their attention. It is frustrating when content are too many on a website. The size of header font and actual content should not be the same and in case there are more than one module positions, there should be enough spaces between them.

When an item is clickable, the mouse should change on mouse over. A clickable item should change the state of content or give direction to another page. To ensure optimal usage, unnecessary adverts on website should be minimized or relate to the content of which the advert is shown. Some webpages trick its visitors in believing images of advertisement on the site are part of the content. For this project no advertisement has been allowed. Text links are better understood than graphical links and the provided link should provide information of its target. Default link colors; blue and purple for unvisited and visited respectively are more common.

3.3 Rich content

There is a possibility for the client to upload video content to support the text of a recipe. The video shows visuals of the cooking process and in order to save space on the hosting service, the video is first uploaded to YouTube or any other available platform that is common to the administrator and the link is copied as a play back on the recipe site. All videos that will be attached to recipes are automatically muted and auto-play is set to false. Allowing audio of the videos to play automatically on an open page disrupts visitors and is annoying. The videos are supporting content in a situation where the text instructions are not well understood. The primary content format is the text because some computers cannot play videos without a plugin player and the computer skills of some users might not be enough to do that.

Clear texts are used though that was the preference of the client. The font size gives enough visibility and a clear distinction is made between title heads and the content itself. Upper case letters are used for titles and its color is set green, different from other text color in black. There is total consistency in the display of text font and colors.

Enough images can be uploaded as part of one recipe though only one will be shown on the front page. A slide show of the rest of the images shows when the desired recipe is clicked. This also shows the detailed content; ingredients, instructions and additional information such fat level. The images should show the appearance of each stage of the cooking process till the end for comparison to what is achieved by the student. This is run internally by the system and does not need any external plugin.

Usability is not another component. It is a process that is followed to make working as smooth as possible. It is part of the design process and should be seen as such. Some web applications are fully implemented before the thought of its usability comes to mind. Others confuse usability with testing so testers are called in when everything is done.

The design is to suit people of different environmental and cultural background. The main languages on the website are English, Swedish and Finnish and no foreign character or symbol of any language apart from the mentioned was saved. The administrator is advised not to copy and paste written content from Microsoft Word or other text editors but to directly input them into the database. Some of these editors have hidden

Meta tags and foreign characters that show up in front end when copied directly. Notepad editor tends to work better than the others.

4 Using Content Management System

4.1 Content Management System in general

The old method by which websites were built was by coding from scratch using HTML or other programming language. The content was static and whenever content needed to be changed, it took the knowledge of HTML to figure out where content should be put. This was repeated each time a modification was needed. The introduction of content management system (CMS) made working on a website easy in an organized way especially when there is a large content.

Content management is a way of having full access and control over all content and deciding on what kind of information is accessible to what group of users. Contents are organized to suit the preference of the administrator. [7 - 65] It comes with many types as some gurus have included Enterprise, Mobile, Component and Web but for the purpose of this project, Web CMS was used hence all discussions are channeled towards Web content. The basic idea behind these types is the same; they should manage content although the approach might be different.

Managing web content allows different group of users to create, manage and store different kinds of content on the internet from a central interface or server, based on the user's authorization level. Manipulating content could be done at the back-end using administrative user right, it could also be manage from the front-end as a registered user or a normal visitor based on the settings of the web application. Most of the popular systems are free and all user rights are managed by the super user or the administrator.

Applications like MySQL are always used to store information to a created database which can only be access by the administrator. Depending on what data the administrator wants to display at the front end, visitors of the particular website will view the information as HTML content.

There is no limit to the amount of content that can be used in the website; it could text, images, and video, audio or other file extensions for example PDF. Latest website development has become very popular among developers and amateur designers be-

cause it comes in a package which gives the administrator ready-made website just after installation. The installation can be done on a local server using XAMPP, WAMP and other available application that works as a local server. The thesis project was installed on an internet server because it makes it easier to edit from any workstation connected with the internet. However, to install on a local server, the downloaded files should be stored in the root folder of the local server. The root folder of XAMPP application is htdocs, and www folder in WAMP.

A website design can be started with or without a basic knowledge of any programming language. The ready-made website has enough content, modules and plugins to start with and the administrator can change the content and modules to suit the required preference. Modification of content might not need any programming knowledge but it is good to have some skills in PHP and CSS to be able to change the look and feel of any content and manipulate it to any form.

The package that comes with the software includes content (text, images, videos and audios), modules and plugins which affect the behavior of the content and a template which holds the content and displays them to the browser. The template and the content are separate entities. Different templates have different menu and module positions and each affect the final look of the pages displayed.

The usage of CMS has grown over the years with users exploiting it in different ways such as blogs, portals, e-commerce websites, etc. Website developers with programming knowledge can build extensions and plugins compatible with their choice. The programming language used in almost all the CMS's are based on PHP so any additional plugin or extension should be coded in PHP and CSS to change the look and feel of how the designed application look from the browser.

It uses a central repository system and allows multiple users to apply changes to content. The highest level of content control is handled by the super user; others call it super administrator with full access control. Other administrative authorization levels are the administrator; functions just like the super administrator but cannot delete some core plugins or modules, authors and publishers has access just to publish, modify and delete content from the back-end. Blog websites and other websites which accept user input or allow users to post comments or any other content also give the right to modify and something delete own content.

4.2 Comparing different Content Management Systems

There are two main types of CMS; proprietary and open source (OS). The use of proprietary requires purchasing a license and depending on the kind of license a user has, shows how far a modification to the application can go but in most cases duplication of the application is not allowed. Other online proprietaries are free and the content can easily be customized to suit the user but to keep it, you need to purchase a domain from the provider of the service. A good example is the Wix online content management. On the other hand open source can freely be used and modified by anyone [8].

In the current trend of website design, general designers are diving deep to the use of open source because it is easy to manage and not hard to work with and free. There are numerous website designers, some open source and some not. Some have managed to dominate the market probably because of their functionality, advanced features and usability whiles others are yet to be discovered as the interest of designers grows and their quest for new interfaces increases.

To be able to maintain a leading position in managing content, developers frequently update versions of their work and have created a simple way to upgrade from an older version to a newer version without losing any data. Third party developers have also been encouraged to develop more extensions and keep a steady pace in the upgrade of their extensions.

Choosing a good designer for a project solely depends on what the designer and the end user want. Basically it is what makes the designer's work easy and provides the end user a user-friendly interface. In my opinion to be able to know how to choose a designer for the end user, the best way is to test the functionality and usability of the site. Most designers nowadays have a demo of how things work and provide a user with login name and password to be able to test the results.

There are many options when deciding the choice of platform; it is not enough to only rely on user friendliness and easy way to get it working. One must also check what version of PHP is compatible with the application and what version is provided by the hosting service in case the application will be on the internet.

As mentioned earlier, there are many of these platforms available and few of them and what they offer are mentioned below.

WordPress is known for its popularity for blogging but it is also a publishing platform that goes beyond blogging [9, 24]. Before it became part of the content management community, it was used only for blogging. Figure 4 shows WordPress administrative dashboard.

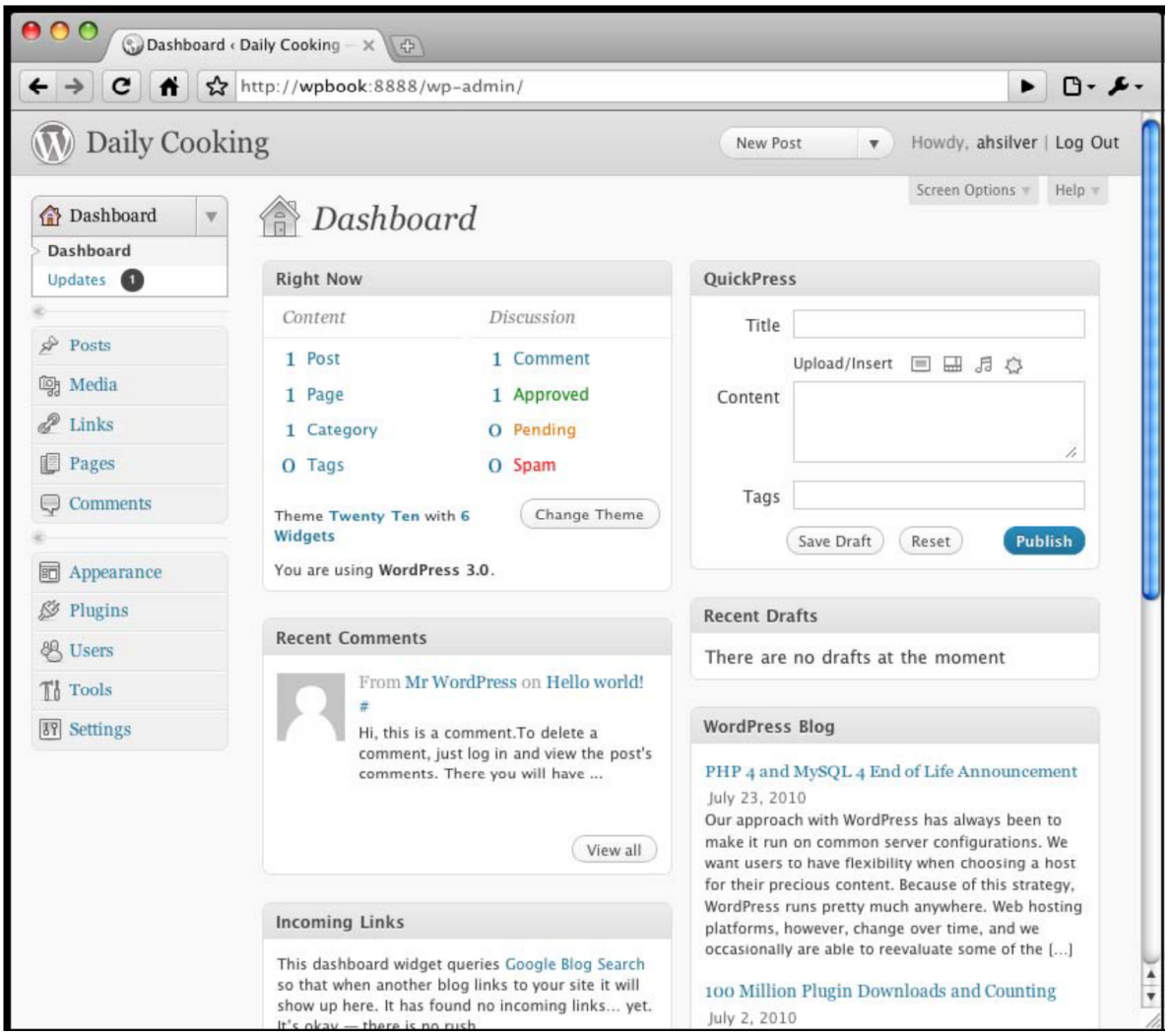

Figure 4; WordPress administrative dashboard

The latest version of WordPress is version 3.5 which automatically updates plugins from the administrative end to save time taking to download newer version of the application. It uses WYSIWYG editor, a way to make life easy for non-programmers when writing text content to a page [8, 47]. Modules can be dragged and dropped from the administrative back-end.

Drupal is said to be one of the secured management systems. On their website they give live feed of updates made by developers and other users in the Drupal community. Figure 5 shows how Drupal administrative dashboard looks like.

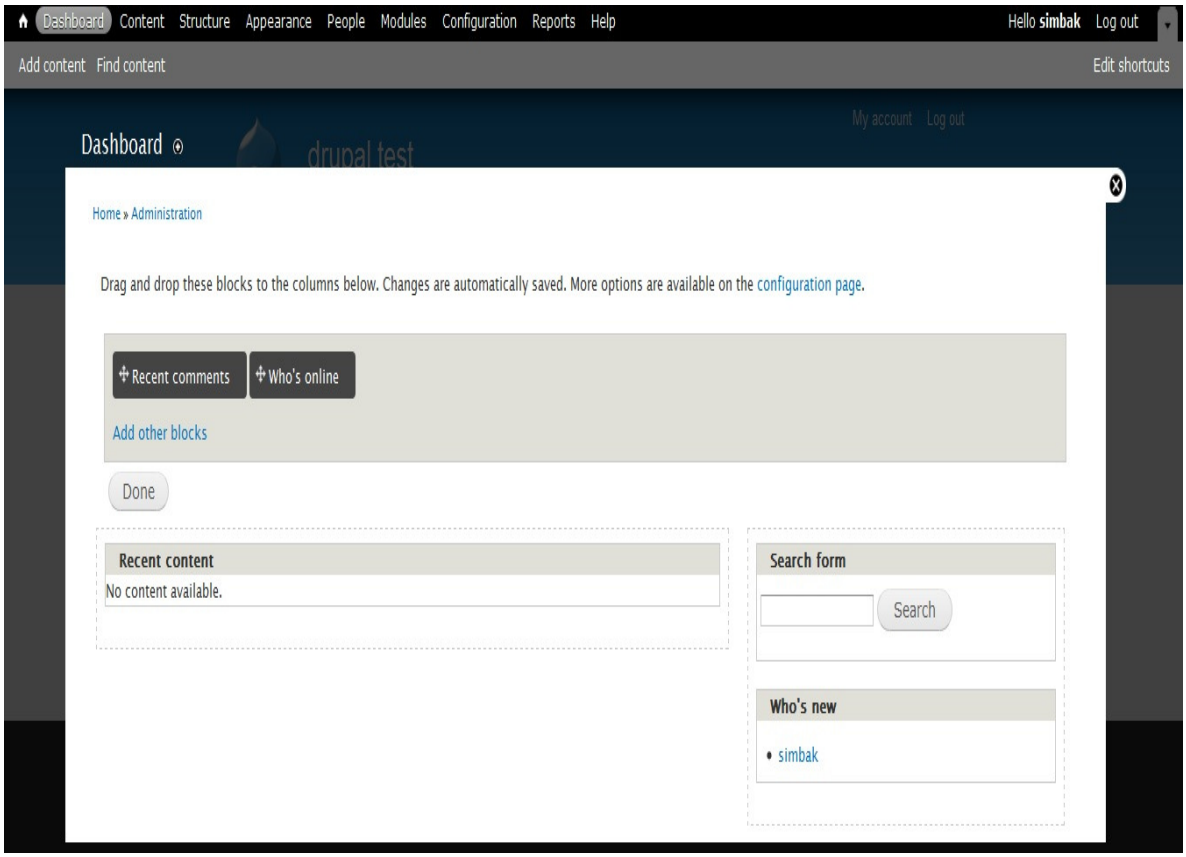

Figure 5; Drupal 7.18 administrative dashboard

Drupal also uses WYSIWYG editor but it is not part of its core add-on, it also enables multiple user groups to edit content. Installation comes with pre-configured themes and modules and it can be customized. The Drupal software could be used for blogs and other portals and they have a large community of users and developers with third party plugin but for a first time user, the user-interface can be a bit difficult to understand. It is available in many countries with many international languages and used by many recognized institutions to build their website.

Joomla is among the popular content management used by designers and it also has an award to its credit. It is easy to work with and is used by major national companies. It is search engine friendly and an administrator has an option to make URLs user

friendly from the administration back-end. Making URLs user friendly makes the URL readable to visitors.

Figure 6 gives a brief idea of how the Joomla control panel looks like. Every update of the platform makes the control panel simple, easy navigation, user friendly interface.

Figure 6; Joomla 1.5 administrative control panel

Joomla possesses advanced functionality, user-friendly administrative control panel and easy installation process. It has thousands of extensions and many other third party plugins but some of them are not free. It has frequent and consistent upgrade to the software. It can run multiple language websites and a community which provide users with help and support. It is designed as a community platform, portal with social networking features. The control panel is well sectioned into language manager which deals with the type of language a user will use as default or multiple languages in case of multi-lingual website, contents as articles are divided into categories just to make it easy to reference and access and the category manager takes care of that.

There is also Cushy CMS which is only hosted online with no initial software installation. Manipulating content requires no programming knowledge and setup takes a short

time. Without the pro version, a user cannot use a personal domain name and number of pages displayed on the website is limited. It does not allow basic account users to change the company's logo or customize for example the appearance of WYSIWYG content like font and font color to match user's website colors. The figure below shows Cushy CMS administrative control panel. This is a demo account of Cushy and to create more space in the demo accounts, all accounts are reset every two weeks.

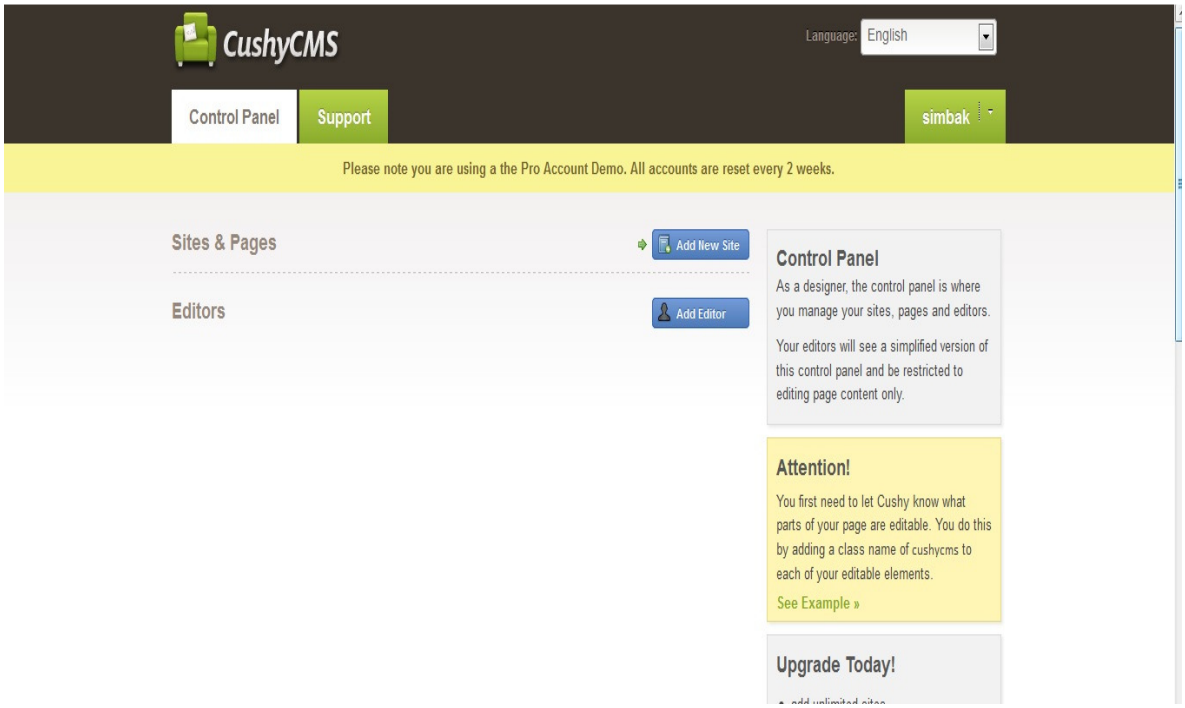

Figure 7: Cushy CMS administrative control panel

The basic application is free for everyone but to obtain more access in customizing the look and feel of the website, an upgrade to a pro version will be required.
Although there are differences in the above mentioned systems, there are also major similarities between them.

The use of MVC has become part of how programmers develop software. It helps to divide the application into parts; one of which contains input and output data, one controls the behavior of displayed content and one display the content in the front end. Modifying just the content, and the look of the template can be done from the back-end of the page but to change the core for example what content are called from the database and how they should be displayed can only be changed from the MVC files which are located in the server. This requires knowledge in PHP which is the language the whole application is built on and MySQL for database manipulation.

There has been many analysis on the most popular CMS widely used among designers and programmers. It is very hard to determine which one of the analysis represents the true figures on the ground since each of the data collected tries to favor particular software one way or the other. The best way to choose the best of the software is to personally test against the designer and client's needs.

The table below contains much information about the most used content management in today's web design. They are all open source software.

Table 1: CMS Comparison: Drupal, Joomla and WordPress. Modified from Rackspace (2012) [3]

	Drupal	**Joomla**	**WordPress**
About	Drupal is a powerful, developer-friendly tool for building complex sites	Offers middle ground between the extensive capabilities of Drupal and user-friendly but more complex site development options than WordPress offers.	WordPress is easy-to-use blogging platform. With an ever-increasing repertoire of themes, plugins and widgets.
Ease of Use	Requires the most technical expertise of the three CMSs. With each release, it is becoming easier to use.	Less difficult than Drupal, more complex than WordPress. Relatively uncomplicated installation and setup.	Technical experience is not necessary; it's intuitive and easy to get a simple site set up quickly. It's easy to paste text from a Microsoft Word document into a WordPress site.
Features	Known for its powerful taxonomy and ability to tag, categorize and organize complex content.	Designed to perform as a community platform, with strong social networking features.	It is powerful enough for web developers or designers to efficiently build sites for clients. Very user-friendly with great support and tutorials.
Best Use Cases	For complex and versatile sites that require complex data organization; for community platform sites.	Building a site with more content and structure flexibility. Supports E-commerce, social networking and more.	Ideal for fairly simple web sites, such as everyday blogging and news sites.

The data provided in table 1 discusses the strength, usability and functionality of each of the three most popular content management systems.

In figure 8, analysis between the three most popular web design software rather looks at how frequently updates are done on each of the software and many other relevant areas.

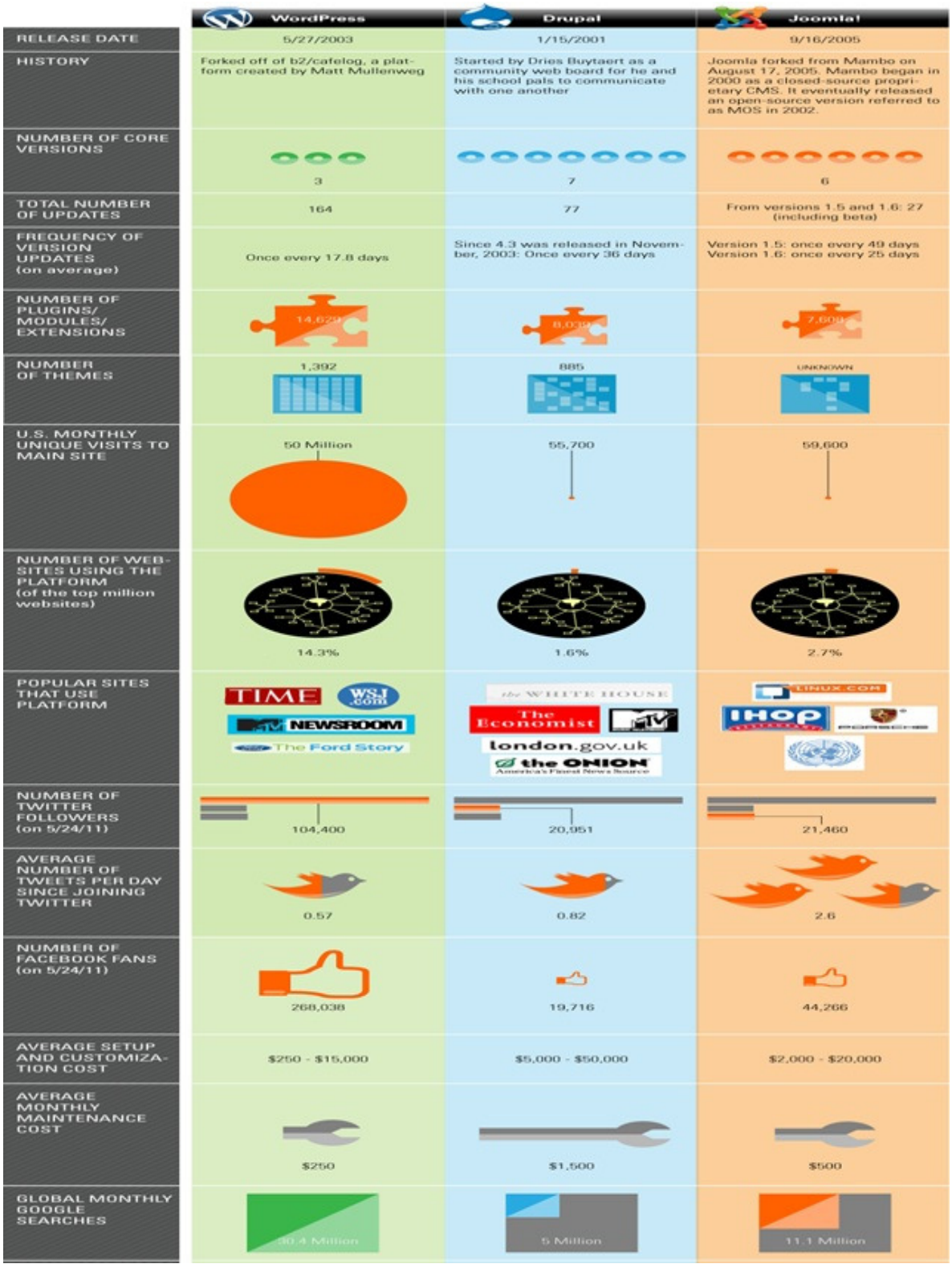

Figure 8: Open source wars: WordPress vs Drupal vs Joomla. DeviousMedia (2012) [9]

The analysis in figure 8 also mentions the number of websites using each of the software and some popular companies and what kind of software is used to build their websites.

4.3 Using Joomla

In this project I used Joomla to design the application. I tested some major management systems and found Joomla to have the simplest administrative control panel which is easy to work with. The installation gives an option to install sample data. The figure below shows how the sample data is displayed on the website when installed.

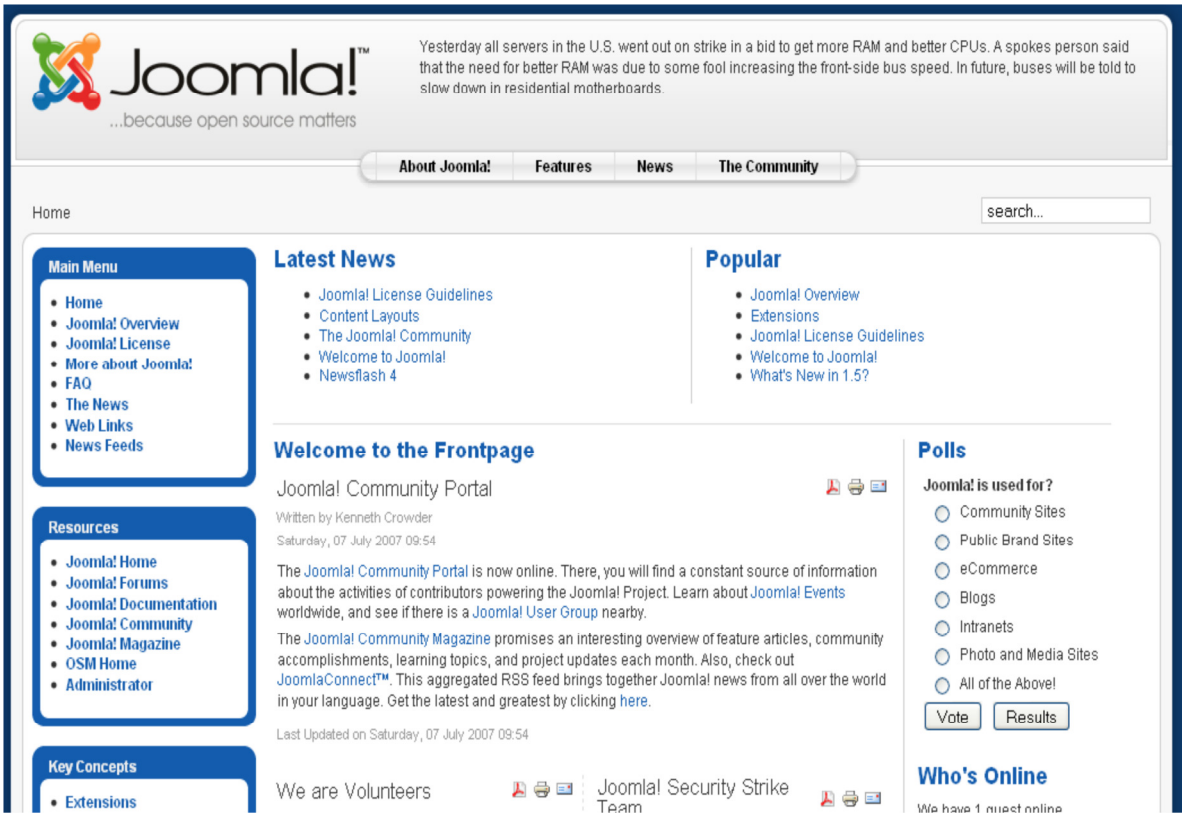

Figure 9 Joomla 1.5 frontend with sample data

When using sample data as shown in figure 6, all the data including menus, modules and pages are pre-installed to guide newbies in understanding and easy modification of the application [8, 9].

On the other hand a more experienced user of the platform may decide not to install any sample data but rather manipulate the platform to fit any needed design. This choice is an easier way to avoid unnecessary content and time spent in cleaning unwanted content and plugins.

The figure below shows the installed template without sample data in the front end. Before this choice is selected in the installation process, the user is asked to select this option if there is enough knowledge to work on it.

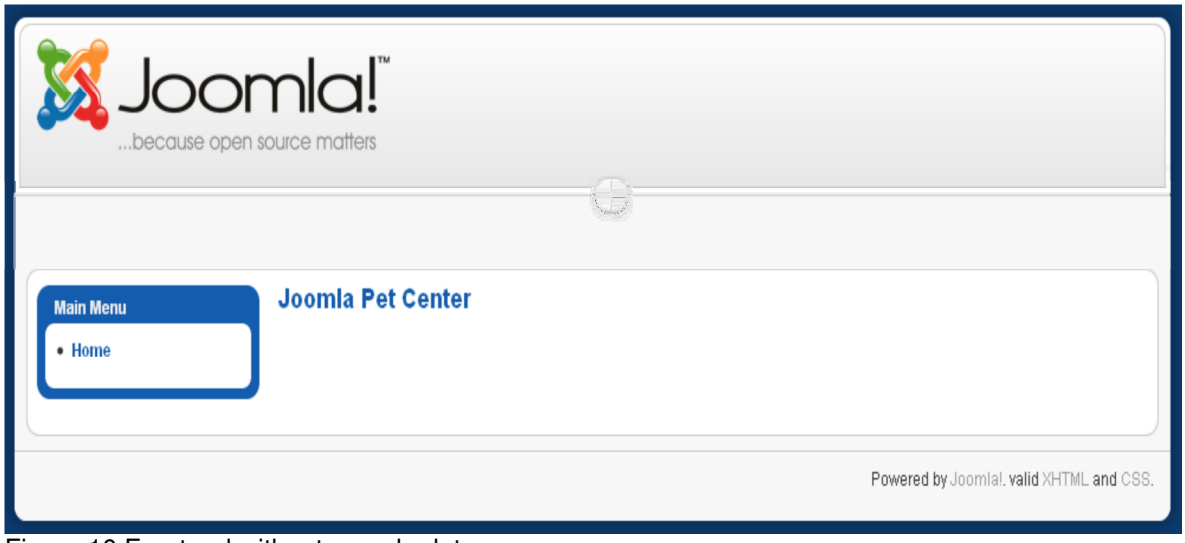

Figure 10 Frontend without sample data

The user front end of figure 10 shows no content and the user have to manipulate the administrative back end to put content, menus and modules to the front end. As mentioned earlier, it takes an experienced developer to work with it.

The platform allows users to install third party add-ons to extend its functionality. Available extensions are of five different types; modules, components, language, templates and plug-ins [10, 186]. The usage of these extensions whether it came with the core or downloaded from a third party can provide any changes needed in the front-end.
There are unlimited third party extensions which give solution to almost every need a user might have and there are numerous documentation on how to install and use the plugin. It has a community with more forums discussing problems and solutions of how to make customizing easy.

There is a frequent upgrade to meet user requirement and upgrading to a newer version can be done from the administrative page. It is an award winning management system and has the largest open source community developers.

Figure 11 shows parameters of an article that in the administrative back-end which allows the administrator to choose dates at which content should be published and unpublished. In a case where articles will never be unpublished, the administrator does not put any date in finish publishing, as shown in the figure.

Figure 11 Article Editor: scheduled publishing and publishing

As shown in figure 11, the administrator is given flexibility as to when articles are published and unpublished and to what specific user group can have access to the article. This way the administrator does not have to manually delete published content when they expire.

Joomla is open source and approximately free, it works well with all operating systems and all web servers. The platform is built on PHP language and MySQL which I already have knowledge of. The super administrator has the right to assign different administrator levels to different users, this helps to avoid deleting plugins and other content by any user. There are lots of free third party templates designs for every sector of business and it's easy to customize. It can run multiple language websites.

Installation is fast and easy even when it is done on a local server. I did the installation on an Internet server and it was just a click that did the installation. Most hosting servers make some CMS available for installation; no prior download is needed.

Security has become a major talk in all walks of life and so is it an issue in the internet world including website development. The safest way of keeping your content secured from other malicious users is to host it on a local server. Joomla provides some security measures for its websites that are hosted on an internet server. It has a security strike team that takes emails from users who find vulnerability in the core code and work to fix it. Another way of making an application secured is keeping frequent updates; updates can easily be done from the administrative back-end or users can subscribe to be notified of security updates.

5 Application

5.1 Requirement analysis

The idea behind the requirement is to understand clearly and in detail the purpose of which the application will serve. This includes the need of the application itself, what the end user wants from the application and what the developer can provide. It is not yet time to discuss how to achieve the requirements at this stage but only to be aware of all that is needed.

In order to achieve success in the final development, series of meetings were scheduled with the client to discuss what the needs of the project are. This is the most important stage of the project, if there is a failure in acquiring the right information, everything will go wrong with the design application. The agreed requirement analysis becomes the basis by the end application is measured. A comprehensive analysis results in on-time delivery, meeting the deadline of the project whiles saving a lot of time and resources. This include both functional and non-functional requirement. Functional requirements discuss what a system can do and non-functional, the qualities and how it should be working.

In major projects, the interest and ideas of all the other parties in the usage of the application should also be considered so that the end product will be a representation of all. It is quite a difficult job if the project is big. For this application, the requirements were presented by the customer and assisted by the developer and the project supervisor. Care should be taken so that the given requirement will not be misunderstood by the design and developing team. It is therefore necessary to adapt to simple and clear words for as a means of communication throughout the span of the project.

For proper representation of the client's idea in the study, Use Cases, user stories and mock-ups that depict the application were designed. This process was followed in the project, the design sent to the client and a meeting was scheduled for acceptance and approval. Changes are still possible if a simulation of the design does not work exactly as it should after completion. Since users of the thesis project do not have full knowledge on computing and web development, the interface was agreed to be as simple as possible and easy to navigate. In some cases, the customer is not fully

aware of what the functionality of the application should be; collaboration in brainstorming brings the best out of it.

There are many categories when dealing with requirement of an application and all of them function in a different way, and deserve to have a critical look at. Figure 12 gives a detailed description of each category.

Category	Description
Functional Requirements	Requirements that define those features of the product that will specifically satisfy a Consumer need, or with which the Consumer will directly interact.
Technical Requirements	Requirements that identify the technical constraints or define conditions under which the product must perform.
Operational Requirements	Requirements that define those "behind the scenes" functions that are needed to keep the product operational over time.
Transitional Requirements	Requirements that define those aspects of the product that must be addressed in order for the product to be successfully implemented and to relegate support responsibilities to the Performing Organization.

Figure 12: categories of requirement analysis [9, 2].

As seen from figure 12, there are four different types of categories needed to achieve a fully functional software application. While the functional requirements deal mainly on satisfying the needs of the customer, technical requirements state the condition of the performance of the software. The above figure mentions a few but it goes beyond that to performance, design and even architectural requirements. A step by step approach in analyzing each of them helps to bring important needs of each.

Before the implementation stage, it is good to set the analyzed data into priorities and for this project, it was organized from the easiest to the most difficult because it makes the design systematic and eliminates double handling of one item. Once a task of a requirement is completed it should be strike out from the list. Some parts of the application might be dependent on others so in prioritizing, the core or the base of the application has to come first and then the independent parts before secondary ones are listed.

After first meeting with the customer, user stories were written. It lists everything the customer would want the software to do and it also includes all the other requirements

earlier discussed. Each need represents one story and they are written in plain and simple language for anyone to understand at first look. The format in writing the stories is to define the user, what the system will be doing for the user and the reason behind the usage. For example I as a user, want to select ingredients and quantity needed for a specific recipe, so that I can put them in a shopping list.

The information of the stories is not detailed as in Use Cases. Use Case is a scenario of functionality presented in an organized manner that gives more detail information and shows all the necessary activities. It can include more than one user and could be an internal application that needs to talk to another before it can operate. A Unified Modeling Language (UML) diagram can be a guide for the testing team when executing their duties. It is recognized in a high level design.
Figure 13 is an example of UML Use Case diagram for a restaurant. This involves four actors; waiter, client, cashier and chef.

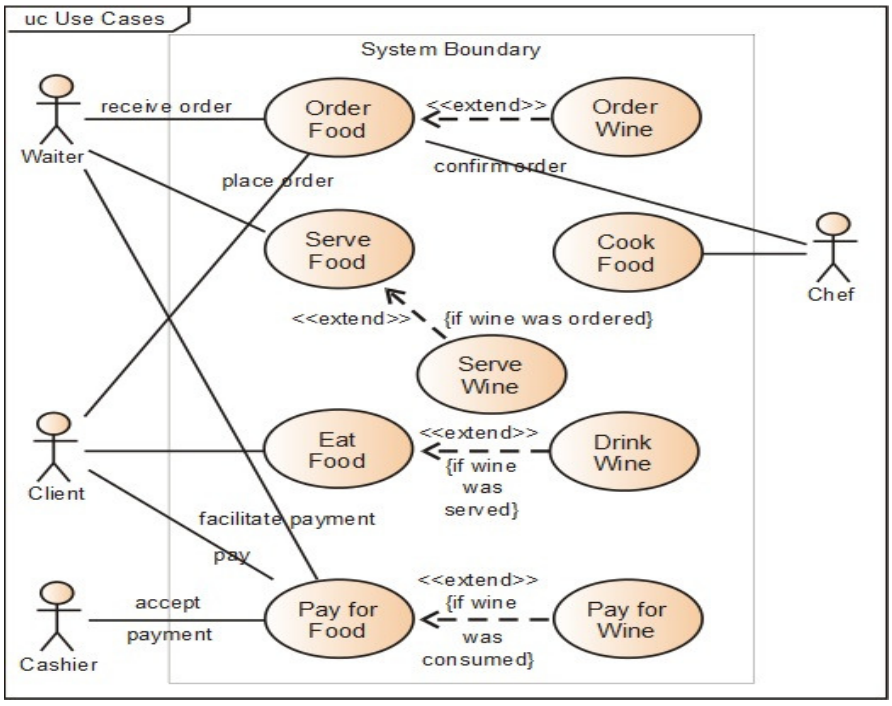

Figure 13: an example UML diagram .Copied from Wikipedia [10].

From figure 13, the waiter and the client can order food, except the chef all can pay for food and only the chef cooks the food. More than one actor can fit into the same role. This is repeated every time a client walks into the restaurant. Main actors in this project are the administrator who exercises full control in creating, modifying and deleting content. Other actors include the manager who is also the client, has the same authoriza-

tion as the administrator, and reads only visitors who can assess all the content without creating, deleting or modifying.

5.2 Mock-ups

A prototype of the application was designed as a simulator for the client to have a clear visual on the design. A meeting was scheduled with the client on the prototype for acceptance to be made before the implementation stage. Changes were still made in the implementation stage as a result of some component having better performance than demonstrated in the mock-up. It was later reviewed and accepted by the client.
Figure 14 is the visual of the main page. This is how the page is displayed after entries are input to the database. The content of the page will be available in three languages; Swedish, Finnish and English.

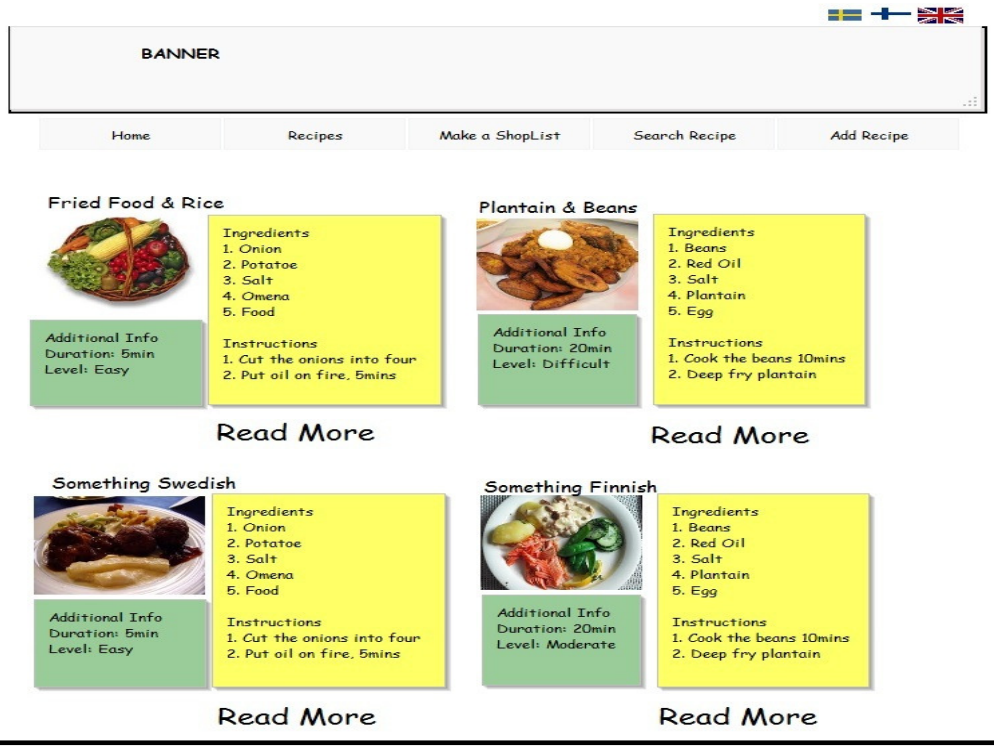

Figure 14: mock-up of the main page of the application.

A click on ‘Read More’ text in figure 14 opens it wider and more detailed. Each will have an image, ingredients, cooking instructions and some additional information. The flags at the top right represents provided languages and a click to them will change the

content to the preferred selection. In all there are five pages and a banner at the top that will show pictures of prepared food in a slideshow.

The client wanted to have a possibility to edit and delete content from the front end and also be able to print as a PDF. Figure 15 depicts the needs of the client. The lists are arranged alphabetically.

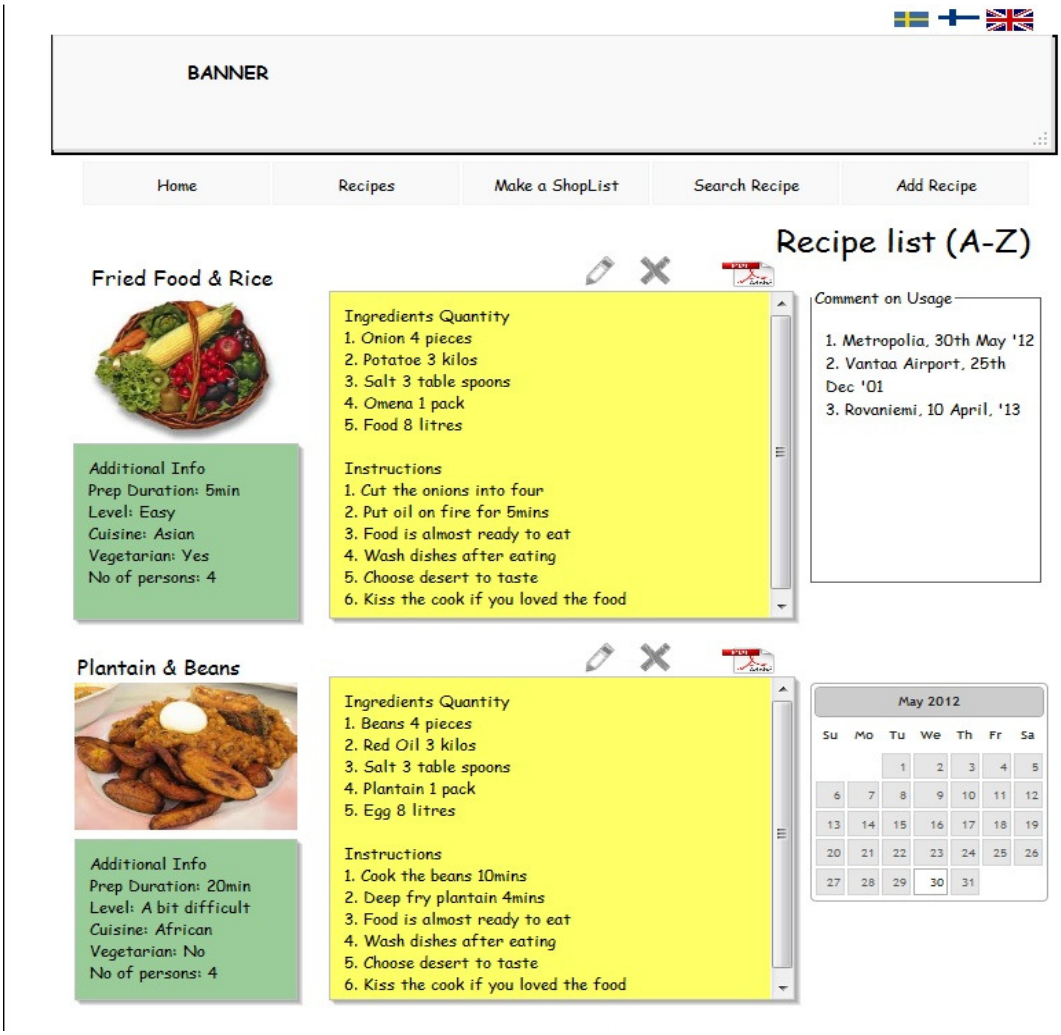

Figure 15: recipe page with print and edit options.

The idea of the text box and the calendar at the right side of figure 15 was that every cooking will provide the date and venue where the cooking was made to keep track so as not to repeat its usage. The administrator will be the only one to see the comment box to prevent others from abusing its usage.

One major interest in the project was to be able to make a shopping list where ingredients will be added to a shopping cart by selection. Sometimes it might already be in

stock and does not have to be included in the cart list. Figure 16 shows how the page will be displayed on the browser. All added items are seen on the page.

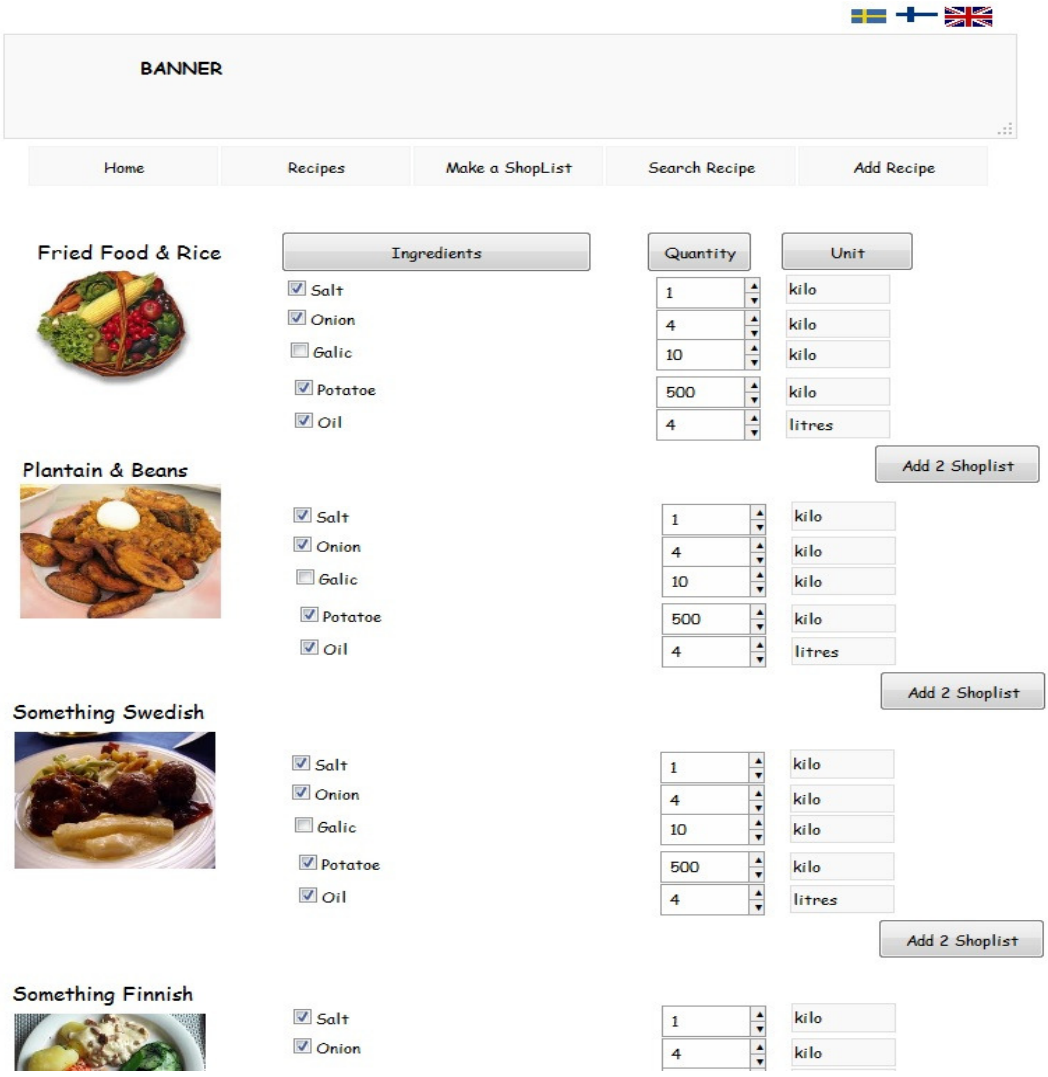

Figure 16: adding ingredients to shopping list.

In figure 16 when an ingredient is selected, its respective quantity can be chosen using the directional arrows. After selection, the ‘add 2 Shop list’ button is clicked and it is sent to the cart. The quantities of items of the same name are put together as one in the cart. Citing an example from the above figure, all the quantity of salt are summed together in the cart as four (4) kilos of salt. The traditional way of doing this was to manually insert and do the calculation in an Excel sheet.

Shopping cart page can be printed as a PDF or any other printable format. A click on the ‘Back’ button will return to previous page. Figure 17 shows two different forms by which this can be done.

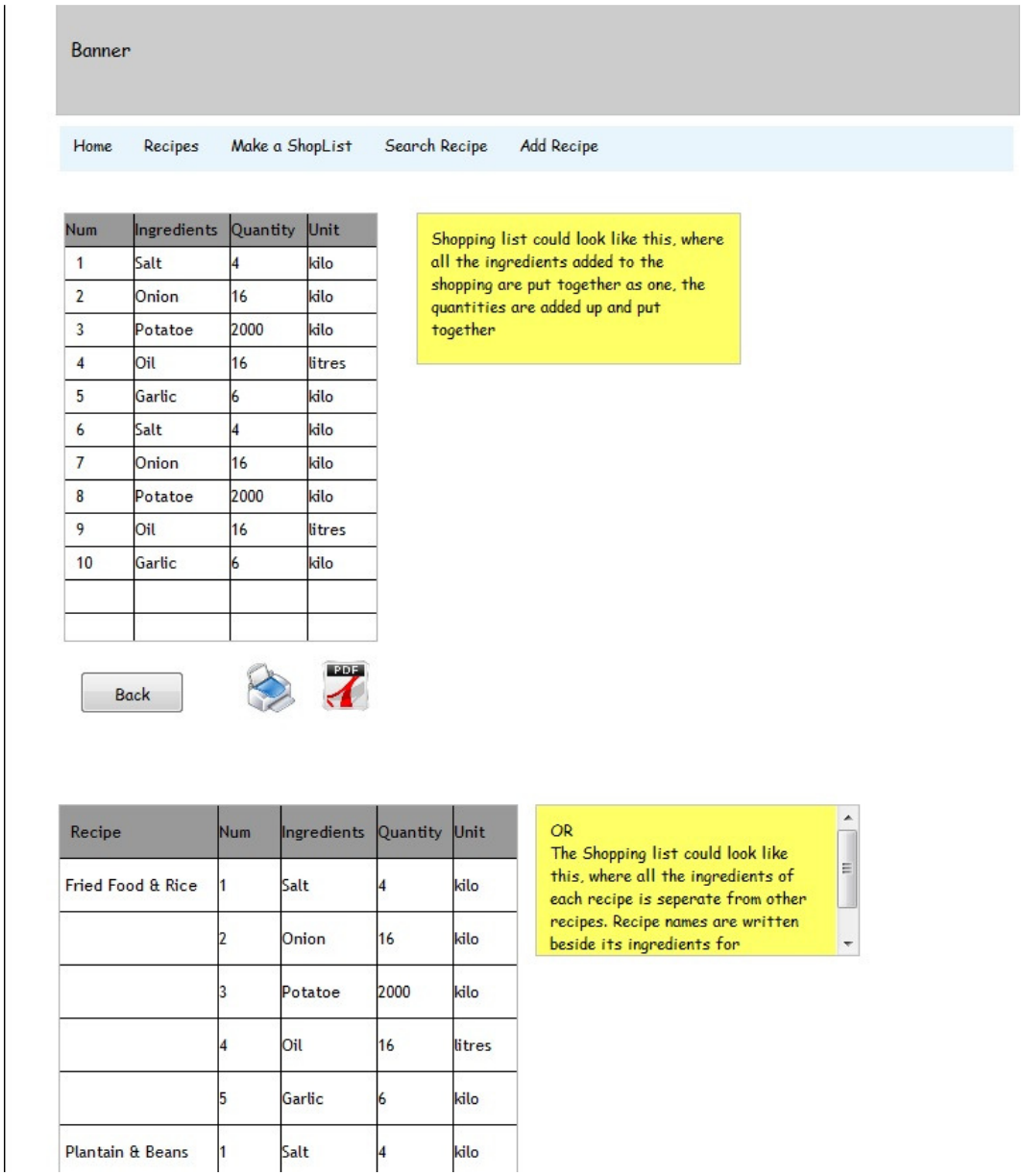

Figure 17: added ingredient in shopping cart.

One option is to add all selected recipes as one which is the first in figure 17 or choose option two; add them individually. The idea of the second option is for clarity on where each belongs.

The database can store as many items of data as possible, and it is easier for it to retrieve the right content upon request. The search page in figure 18 allows users to be specific in their search without having to go through all of them. Search content will give the name and the image if there is any and the description.

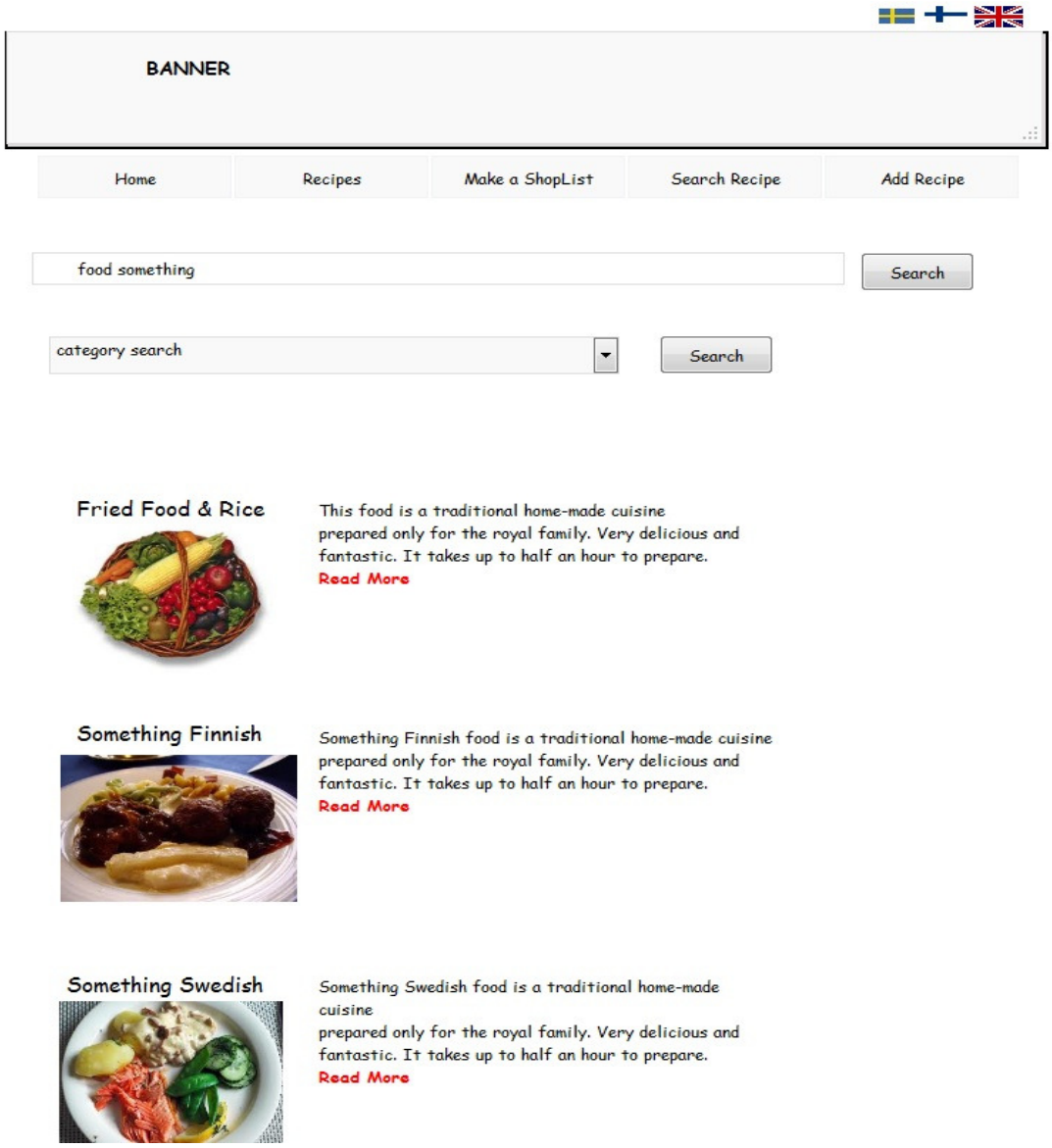

Figure 18: available searched items in the database.

A match to the text in the search bar will be displayed. To make it even easier, search can be made by category. If nothing is found, a text to that effect will be shown. In figure 18, there are three matches to the search text input.

Content can be created from the front end of the application but this requires administrative rights to prevent anyone from creating one. In figure 19, not all the information is needed but title, instructions, ingredients and image are the necessary ones.

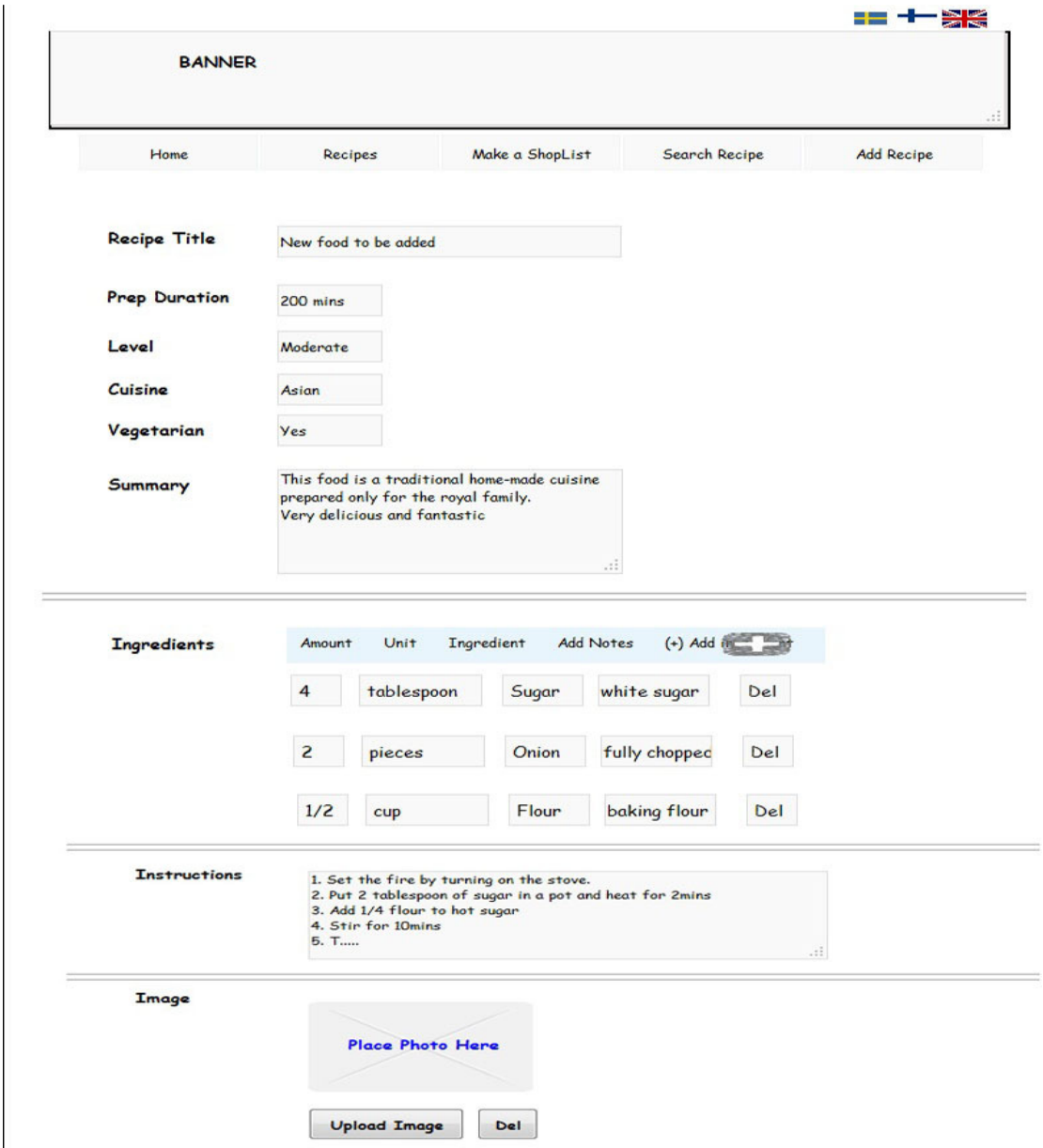

Figure 19: adding recipe to database.

In the image section of figure 19, more than one image can be uploaded but if none is given, it will be replaced with a default image. After a successful creation, the system asks if the administrator will create another one or log out.

5.3 Implementation

Implementing the project started with planning and organizing the necessary tools needed to develop the application and the workflow of how components will be put together. A project plan that contains all project tasks for each period was made. The

duration of each time period was two weeks and tasks were drawn in a way that it prevents idling of created component that cannot fully function. There are step by step phases used in achieving the implementation goal.

First there is the planning stage which defines the strategy and approach of work and its available resources. A research was conducted in finding tools and the platforms that best suits the needs of the application. As there are many tools for that matter and testing was done before the chosen tools were accepted in this stage. Based on this project a backlog which lists all the needed functionalities was created to check the progress of work. The already set priorities were written to fill the product backlog; the foundation of the application comes first and after that other components which can function with the help of the core foundation are put added in the next period of design stage.

It had already been agreed in the planning stage to use Joomla as a content management software platform in the design and the needed plugin to help in the execution of the project was also found. Materials such as pictures for the work were taken from the client so this stage was to demonstrate just how to use the availability of tools, materials and platform to achieve the product owner's goal and therefore they were not again included in the project backlog. To keep the focus of the project intact, the final finish line of its functionality and usage were kept in mind as a guide.

The time needed to finish one period of sprint was calculated and estimated to make sure there will be no late delivery of the finish product to the client. Tasks were broken into smaller pieces to allow the workload to be finished as estimated. In bigger projects that involve project managers, testers, designers and developers, scrum as tool or working model is a commonly used method. Scrum meetings are conducted at the beginning and end of each period or sprint. Each team shares the target to be achieved at the end of each scrum or period. The scrum method was executed in this project; it involved mainly the developer, supervisor and representative of the project owner.

Before starting the first task, a project review was done with all parties involved to brief them on the current and next design implementation stage. Work in each specific sprint was calculated in hours. Activities of the next sprint were defined at the end and review time of the previous one. The sprint could be marked as successful and completed or otherwise. Unaccomplished tasks in the previous sprint were sent to the backlog and

by review the reason of the failure was found out and new working approach was provided. The tasks for any of the sprints periods were selected from the list available in the backlog.

At first work was on the database, to test how data is stored and how it appears in the front-end. The database and its tables are automatically created when the content management system is installed and the plugin for the design also inserts its own tables to the already created tables. Data were entered directly into the database of the hosting server through the administrative back-end and called from the view controller, which is in charge of making all content appear on the front page. The data was later modified and deleted and the outcome result was successful.

The product owner had little knowledge on databases so it was decided to create a menu on the front page that allows only those logged in to create or modify an existing content. Another administrative credential was created for the owner and a menu was created to accept login info and give access after a successful log in. Before the acceptance of front-end content to the database, it should belong to a category. The category organizes recipes that belong to a common group and an example of the created categories were; Africa, Middle East and the Far East. Sub categories were made according to the countries from which the food comes from. After this, the first recipe was successfully created in the database from the front page.

An item is considered as done when it passes a unit test after its implementation. The definition of “done” has to be clearly defined and after the end design, a check should be made against the definition before it can be considered as completed. At the end of the sprint, the main page that shows all stored data in the database, the category menu that shows the group names by which each data must have at least one relation to, and the add recipe page that gives access to only those logged in were considered as done. However, the owner still wanted to make some changes to the look and feel of the interface which gives an idea that the completion of a single design does not necessary mean it is done. The final completion and acceptance of the whole project can be taken as done.

In an environment where there is no access to the internet and there are several foods to be prepared, the tutor will have to manually input everything needed for cooking in a text editor and print it out to participants. All items on the front page contain two buttons

that can print individually or add multiple items to a print cart. The target for this sprint was to create a ‘print cart’ menu to keep the already chosen recipes by their name, ingredients and the cooking instructions.

Listing 1 shows part of the code that takes care in the handling process how a single item can be printed directly or saved to a cart if there are more than one items.

```
if($this->config->print==1){

$prnt_url=JRoute::_('index.php?option=com_recipe&view=recipes&ta
sk=print_recipe&id='.$item->id);

echo'<a
href="javascript:void(0);"class="recipe_print"onclick="window.op
en(\''.$prnt_url.'\',\'win2\',\'width=800,height=400,
top=100,left=100,scrollbars=1\')">'.JText::_('PRINT').'</a>';

if (in_array($item->id, $recipes)){
echo'<span id="recipe_cart'.$item->id.'"
class="recipe_cart">'.JText::_('ADDEDTOPRINTER').'</span>';
}

else{
echo '<span id="recipe_cart'.$item->id.'">
<a href="javascript:void(0);" class="recipe_cart" on-
click="add_to_cart('.$item>id.');">'.JText::_('ADDTOPRINTER').
'</a></span>';
  }
}
```

Listing 1. Print or add recipe to cart buttons

The first ‘if’ in listing 1 checks if a recipe is active or available by locating its identification in the database. If it is available, the print button is positioned beneath it and a click on the print tab will open a new window to handle the print. The second array however checks from the print cart if it had already been added. If the identification is found in the cart, the text ‘Added to Printer’ can be viewed in the ‘add to print’ button but deactivated. Otherwise the button will be active and can be saved to the print cart.

A similar menu that handles all ingredients needed to be purchased was created. It is selected from Cooking of the day list and added to the cart by clicking on the ‘add to cart’ button. The traditional way to do this was for the project owner to input it in Microsoft Excel. To simulate the same in the implementation, a comma separated values

(CSV) was implemented so all the content on the page could be exported in the CSV format in the same way as it was done in Excel.

In listing 2, items that are in the ingredient cart can be exported as a comma separated file and it is best opened in Microsoft Excel. This is accessible to all visitors of the site.

```
<a href="javascript:void(0)" onclick="window.open
('index.php?option=com_recipe&controller=csv&task=export_data',
'Csv', 640, 480, 1);" style="text-decoration:none;">

<img src="components/com_recipe/assets/images/export.png"
height="50" width="50" alt="<?php echo JText::_('CSV'); ?>" />
<br />
<span>
<?php echo JText::_('EXPORT_RECIPE'); ?>
</span>
</a>
```

Listing 2. Export to CSV

Listing 2 is an image link for exporting content. Everything in the cart is also stored in the controller folder of the plugin under the name export_data. When the CSV link is clicked, it opens the copy of the stored data from the export_data file.

The target for each sprint included all additional features such as print, add to cart and add to print cart buttons. Some of them were implemented once and displayed many times on different pages. Though the end of the sprint period should have marked the end of the whole project, modification of new ideas in the behavior of each function still continues.

5.4 Search

In the administrative back-end of the Joomla core, there is a provision to write a metadata that describes the works of the application. Keywords that best describe the page can also be written. This process is called search engine optimization (SEO); it

announces the presence of websites in search engines for website visitors to easily find content of a web page. The system ranks websites in terms of the number of visits it has received and the outcome is found in the search results. Being ranked at the top of the search means visitors can easily access its content which is a good idea in terms of marking of the website.

The target area of this application is not very wide and it is only aimed for now at specific people in a specific location. Outside of this area, the product owner does not gain anything from the usage of the product. Meta tags and keywords were written to enable search engines to easily target and trace the website when a web user input any of the tags as a search word.

Another search engine for this project is to internally fetch content from the database and displays it in the front page when a request is given by the user. The code shown in listing 3 fetches all available data from the database.

```
if(isset($srch) && $srch == 1){
$query = "SELECT r FROM #__recipes left join #__users as u on
r.user_id=u.id";

if($type=='0'){
$query .=" WHERE r.ingru like('%" . $search . "%') AND
r.published=1 ORDER BY r.name asc";
  }
}
```

Listing 3. Ingredient search component

The first line of the code in listing 3 checks the search text box if there is an input. If there is, it injects a structured query language (SQL) query to select all the matched items from the database. After that, it filters the matched results to only its ingredients and if it correctly matches the search request, the results will be displayed in an ascending order.
This component only looks for ingredients that are available in the database. With this, the output results will be more specific. The second internal component looks for available categories. It uses a drop down menu and shows all categories for selection to be made. A selection shows all items linked with the selected category.

6 Testing

6.1 Different kinds of testing

Testing a web application involves a thorough assessment of every designed piece to be sure that the result of the given input corresponds to what is expected. All kinds of web testing are done to be sure that everything works as planned before the application is finally delivered to the owner. This should be included in the early stage of any project. For effective testing approach, the behavior and the look and feel of the application has to be evaluated individually.

A usability testing should always be done because it is a way of checking the friendliness of an application and to be sure that users can easily understand and navigate to the needed content. Help is provided for more clarity of what a unit is supposed to do and what should be expected. Usability focuses on the visuals of the client and it must be pleasing. Graphics and text used should be self-explanatory. Feedback from a third party user, and not from the design team will be a good way to assess the success of the user interface. It should eliminate any uncertainty from the minds of visitors of the website [11, 4]. With this successfully achieved, the aim of the user is satisfied efficiently.

Functionality is another approach of evaluating the efficiency of an application and it is one of the processes of ensuring quality. More attention is placed on the output of a given input. The result is compared with the functional requirement which was written before the start of the project. [12]. It is to validate conformity and compliance to written specifications. Every feature of the design at every stage is looked at. It helps in the delivery of bug free web application at the end of a design. There are many ways of conducting such test with one being the use of written script. The process includes first identifying what kind of function is there to be performed. The stage next is inputting data as per specification. After that the output is taken and a comparison is made between actual and expected results [16]. How the system works internally to generate the results is not necessary in the functionality testing.

Loading is a performance check to obtain knowledge on how fast or slow a website is fully loaded in a browser. It is important to know how much load is exerted in peak time and whether failure occurs or the required time increases. This is normally conducted

using online available tools that serve as a simulator. It takes into consideration the loading speed and the time difference taken to fully render a page. This is also known as stress testing.

The database is as relevant as other areas of the design that has to be looked at. This is to check if the requested page from a visitor of the site has taken the right data from the database. One way is by observation at both front-end and back-end. Whatever data is entered from the front-end, it should be seen at the back-end and the results given to the user should come from the database. A check can also be done only from the database by injecting structured query language (SQL) queries but this method requires the knowledge of SQL. It would be easiest to use SQL analyzer which does the job.

6.2 Testing techniques

The idea behind testing the application was to ensure that all functionalities of the application have been checked and expectant results which reflect the purpose of the application have been met. In other cases the test is also to find and fix errors and loop holes in the application that might crush the application or give false results. For best results, this is done by a person different from the developer and guided by test cases which make available expectant results of how the application should behave.

A good way is to test along with the application development [13, 2]. This idea can be implemented in all design methodologies and it makes developing steps easy. This process was adapted in the entire design of the application for the project. It was applied to each stage of development to locate and fix errors and to make sure that the output results is what was needed by the client.

The basic software techniques used are general testing methods which include positive and negative, black box and white box, error and automatic software testing. Another technique deals with the functionality of the application and includes random and static among many other methods. The last technique is non-functional; testing the configuration and compatibility of the application. [14, 16]. All these techniques were used in the project application.

In applying positive and negative techniques to the project application, the process was done against written test cases and the idea behind the positive method was to ensure that the application reacts as it is intended to. The negative method monitors the reaction of the application when a process for example saving a new recipe is interrupted in process. Interruption can be cancelling the saving process or closing the browser.

Black box and white box methods are based on the former concentrating more on the output results against its input with the later focusing on the operation of the system [15]. The method applied to individual component used in the development stages of this project application is an aspect of the white box method. Components were tested separately before a general one was done during the last development stage. Though some components are built separately, this changes the way other components behave. Therefore there is a need for retesting all components in every design stage and when any modification is done.

Static testing was conducted and it only checks the visualization of the application. In a written conversation with the client, one of things the client suggested was to change the font type of all text to Maiandra and to avoid unnecessary spacing by implementing a line spacing of one. In the static method, the font was checked against the user's requirement.

Another way of which testing was done was with the system. The application was tested with most of the popular web browsers such as Mozilla, Internet Explorer, Google Chrome, Safari and Opera. The purpose of this was to observe the behavior of the application in all these browsers to see whether it behaves in the same way. It was also applied on Windows and Mac operating systems.

Stress analysis is another method used in the application. The stress method is done beyond the needs of the application [8]. An example of this kind was the ingredient search module of the application which should output expectant results of available ingredients the user is searching for. The search module only takes text input so using the stress method other special characters like '! ", %, &, ~' were used to test how well the application can handle them without crushing the system.

Also a performance test to monitor how fast user request are processed and results returned to users was done. The process was again analyzed on major browsers and

operating systems. It is difficult to know exactly how fast a request is processed since the application is hosted on the internet and the internet speed of a particular network affects the behavior of the application. Another problem that affects the behavior of the application in terms of performance is the speed of the computer hardware from which the request is sent.

Usability testing was done at the early stages of the application development. It was done against the user requirements which were given before the start of the project. Usability testing takes into account the user- friendliness, user interface of the design and navigations in the application to make them easier to follow. It also takes into account that the application can be used with little or no guidelines or training.

The last stage of the process which is acceptance is done by the client to ensure that the output results are the results the client expects. The client was guided with the help of test cases to help in testing the functionality of each component on every page of the application. The given guidelines show all the components, expectant results and a feedback space to be checked whether they were successful or not. Reported defects in the application are corrected.

Figure 20 illustrates the method in which each of the phases was done. This approach is repeated until no error is found in the output of the application results.

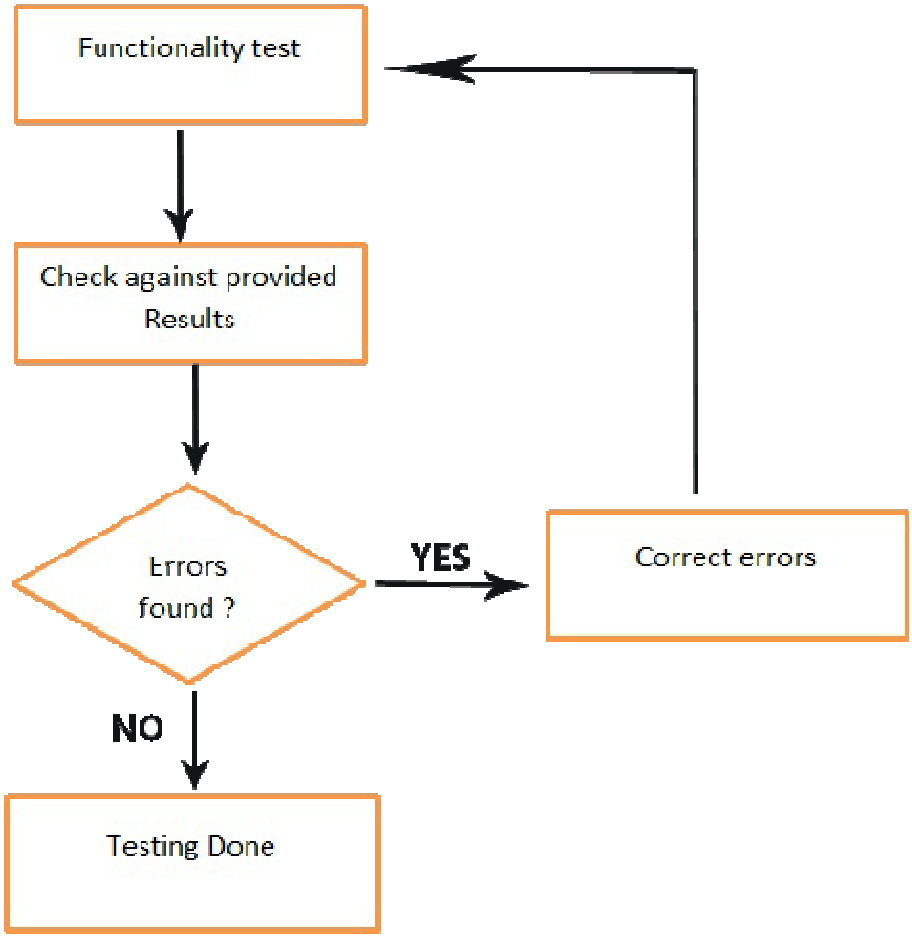

Figure 20: a flow chart of how functionalities were tested

After each test, the output is checked against the provided results in the test cases. If the result is not the same it means there is an error. As shown in figure 20, there is a continuous loop when an error is found. The errors are corrected and the failing function is rechecked.

The purpose of volume testing is to monitor how much content the application can take and this was also checked. It takes into account that the client can save as many recipes as possible without the application crushing. It also ensures that an unlimited number of ingredient and images can be added to a recipe without any crush.

All the above mentioned tests helped to know and understand the reaction of the application. The testing is completed when all functionalities and the performance of the application have been found to conform to user and system requirements. On the other hand testing never stops as long as the application is being used. Due to increase in

technology and computer software, this will help to make the thesis application compactible to yet-to-developed computer software.

6.3 Testing process

The process of analyzing a software application includes planning and control, analysis and design, implementation and execution, evaluating and reporting [13, 20]. In the planning stage, different kinds of user groups of application were taken into account. From the beginning it was understood that users of the site will first of all be the client and other users in the recipe class. Because the application will be hosted on the internet and can be accessible to anyone, there was also the need to take all users into account in the planning stage.

At this stage, test schedule which tells how long it takes to complete one cycle of the process was carefully considered. However, it was not implemented and no deadline was given. The time factor in this case depends on how well the client is acquainted with an operating system or the speed of the computer itself. The idea was disregarded since it cannot be used to test the speed of the project.

In bigger business companies, the processes are done by the quality assurance team [14, 31]. Testing is done in stages and hierarchically and a team is assigned to every department that will use the application. Each person in the testing team has specific responsibility on how the process should be followed. In such companies, the process and method is at times broken into parts so that users can work with parts of the software which will be accessible.

Figure 21 shows the hierarchy in bigger business companies with individual teams and a team leader to each team. The highest authority in the hierarchy is the senior management.

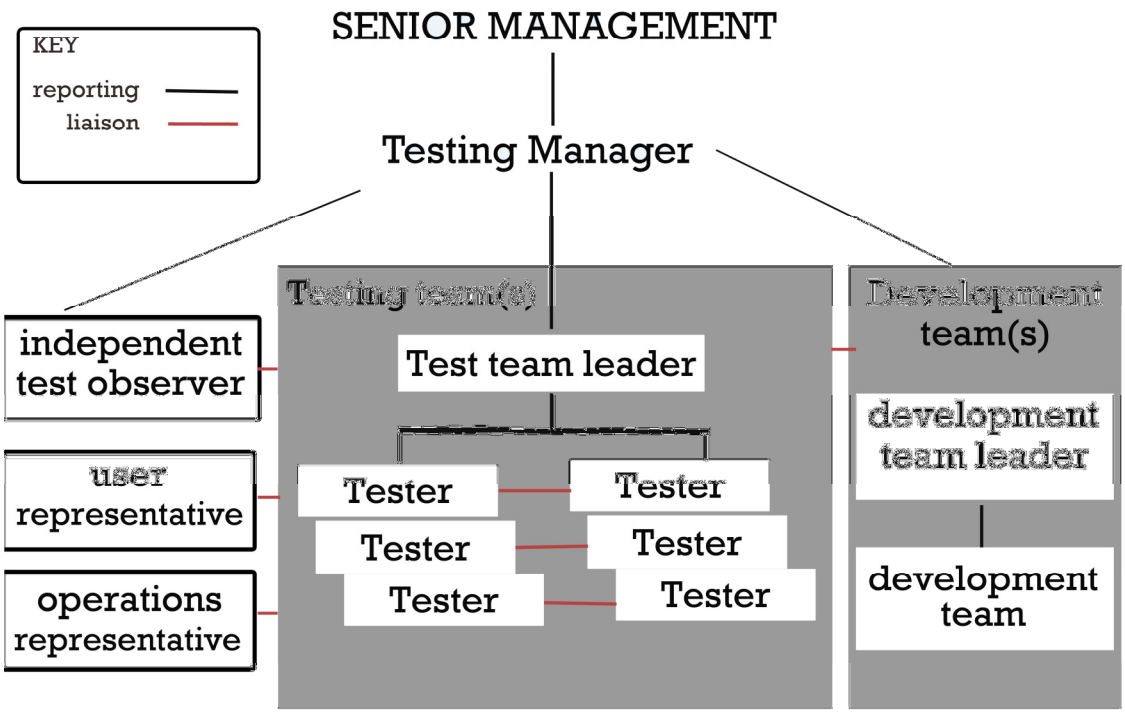

Figure 21: organization of the test process [14, 329].

The figure shows that the development team reports to the team leader. However, it is the responsibility of the team to feel the analyst ways in which general testing should be done. This strategy was not used in the project application because it was a small project done for a small group of users. Writing test analysis was done by me, and the client was tested based on the analysis. Based on figure 21, the client acted as the independent tester.

The execution stage of the process for this project was where the client based on the plan conducted a test and reported back if any error was found. After successful completion, reporting the results of the execution is necessary to inform the client that the application is fit for use. A report is also written if the test was unsuccessful and the application will not be released until the bugs are corrected.

The process was repeated three times to make sure the first results which were almost exactly as expected did not fail. There were some irregularities in the results compared to earliest results and their display was a bit different from each other. The content of all the three results were the same but the order of which they were arranged was different in each one of them. In one of the pages, the content is supposed to display in-

gredient of a recipe, the number of unit of each ingredient and what kind of system is used to measure the ingredients and the resulting output should put the ingredient, unit and the measurement in one column each with enough space between each column.

Some of the results had all the columns overlapping with each other in one column, others displayed the three columns but did not have enough space to differentiate which content belong to which column. To solve this, a modification was done in the cascading style sheet (CSS) to give enough space and the application was tested several times to make sure all contents are displayed equally.

6.4 Writing test cases

The cases are written against the project backlog that is planned at the beginning of the design stage. The main idea was to be able to test the output of all functionality in the application that receives either a user input or a mouse click as a command to display specific results. It is relevant to make a cross check on the cases to avoid oversight of leaving out some functionality. The cases show the behavior of the application after executing a request.

The writing was done in a simple way in order to make it easier for the client in the process; this is to make the client understand each step of the process. In this case Microsoft Excel was used in the design and it was arranged according to how the pages are displayed on the screen. All the functions and units in each of the pages were included. Many of the Excel items are repeated because they are found on almost all the pages. Though a function might look the same on every page, it is necessary to test it on each individual page to make sure that the given result is same for all pages.

Figure 22 shows a captured image showing the structure of the test case. It is divided into action; listed under it are each unit to be tested represented in an individual cell, and the expected results which tell the client what to expect. There is also a comment box in case the client wants to add or suggest something.

Action	Expected Result	Pass	Fail	N/A	Comments
Main Page Testing					
Search for recipe name by clicking on the alphabet	Displays recipe(s) names starting with the click alphabet				
If selected alphabet does not have any recipe	Display no such recipe is available				
Click on a recipe image	Shows detailed recipe with ingredients and cooking instructions				
Click on a recipe name	Shows detailed recipe with ingredients and cooking instructions				
Click on print button	Pop up window showing detailes of the recipe to be printed				
Click add to print cart button	Pop up alert window with "successfully added" as text				
Click **OK** from alert window	Add to cart button text changes to Added to cart and recipe is sent to print cart				
Add the same recipe to print cart	The button should be disabled because it has already been added				
Select recipe category from the drop down at the top	Should display recipe(s) under such category if any				
Search for recipe by ingredient from the top right search bar	Should display recipe(s) with such ingredient if any				
Click on the Swedish flag at the top right	Language of content should switch to Swedish				
Click on the Finnish flag at the top right	Language of content should switch to Finnish				
Click on the image of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Read More of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Recipe Name of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the image of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Recipe Name of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the image of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Recipe Name of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Scroll down to button of page and click Next	Displays the next 10 set of recipes				
Scroll down to button of page and click End	Displays the last set of recipes				
Testing Recipe Categories page					
Click on a category image	Shows all recipe(s) of such category				
Click on a recipe category name	Shows all recipe(s) of such category				
Click on Sub Categories text	Displays sub categories of the main category				
Click on print button	Pop up window showing detailes of the recipe to be printed				
Click add to print cart button	Pop up alert window with "successfully added" as text				
Click **OK** from alert window	Add to cart button text changes to Added to cart and recipe is sent to print cart				
Add the same recipe to print cart	The button should be disabled because it has already been added				
If recipe has been added to print cart from the main page	Add to print cart button should be disabled because it has already been added				
Search for recipe by ingredient from the top right search bar	Should display recipe(s) with such ingredient if any				
Click on the Swedish flag at the top right	Language of content should switch to Swedish				
Click on the Finnish flag at the top right	Language of content should switch to Finnish				
Click on the image of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Read More of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Recipe Name of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the image of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Recipe Name of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the image of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Click on the Recipe Name of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)				
Select number of categories to display from display drop box at buttc	Display number of categories base on selected number				Does not work

Figure 22: copy of some of the written test cases

In bigger projects, figure 22 should include name and department of the tester but in the case of just two people as in this project, that was ignored. As illustrated in figure 22, every single unit of every page was listed in the items. Every unit has its respective

expected results which gives a clue to the client of what result is required. All results will be checked against the provided results. Irrespective of the outcome of the results, the client must mark whether it passed or failed and in an instance where a function gives no results. Also the not available (N/A) column must be marked.

6.5 Test results

In all about seventy seven (77) cases were written to guide the client in the process. It turned out that ninety percent of expected results matched the observation results. Among the items that failed the test was “remove all”, a button that is supposed to remove all recipes added either to a print cart or an ingredient cart. In the observation results for that item showed null.

Though the majority of the items passed, in some cases the way they were displayed on different operation system varied. The application was mainly designed on a Windows operating system so all the earlier errors were corrected and adjusted to suit the graphical requirement of the project. The usage of other operating system in the process would not have been necessary if the project was hosted on the client’s personal computer, in that case the client’s operating system will be used for the design.

The performance of the application was also checked using a web based test management tool. The idea was to test how fast the application loads when it is first opened, it was realized that the time taken to run the site a second time was always smaller. The test was done on both Windows and Mac operating systems. The results can be influenced by the processing speed of the computer system and many other factors.

Figure 23 depicts the results from the web management tool. The figure shows a snap shot from both Windows and Mac computers. It checks the start time to render the website. From the Mac computer, some of the images are not fully rendered.

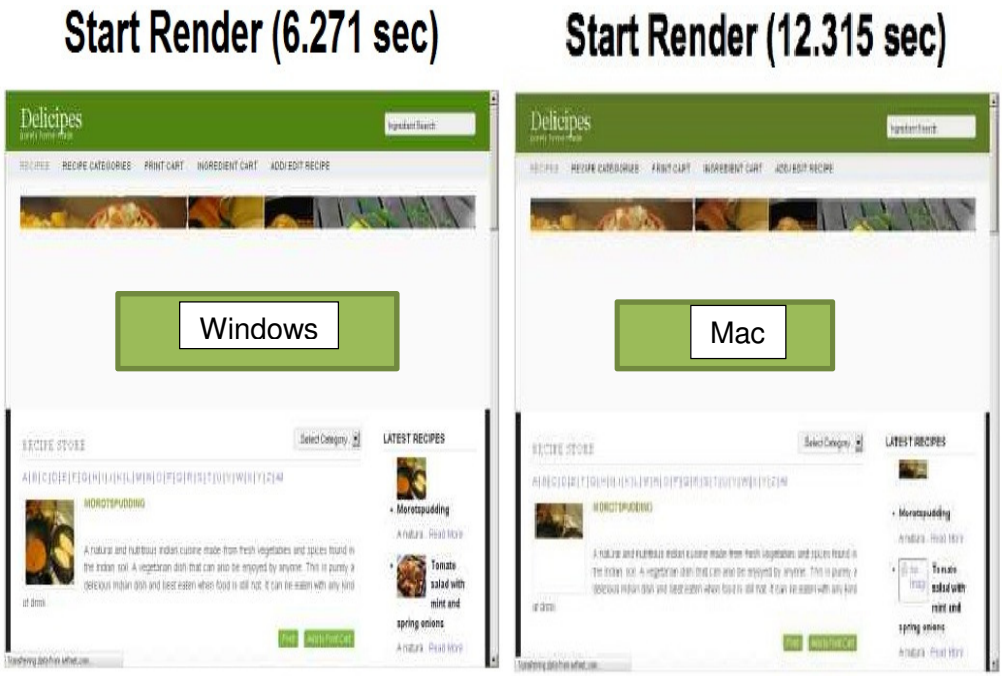

Figure 23: time taken for site to render on both Windows and Mac computers

In figure 23 the time taken to start the application render in Windows is smaller than in Mac. The colors of the website also differ but that is just because of the screen difference.

Figure 24 is a fully rendered website and the time it took to complete the process is shown.

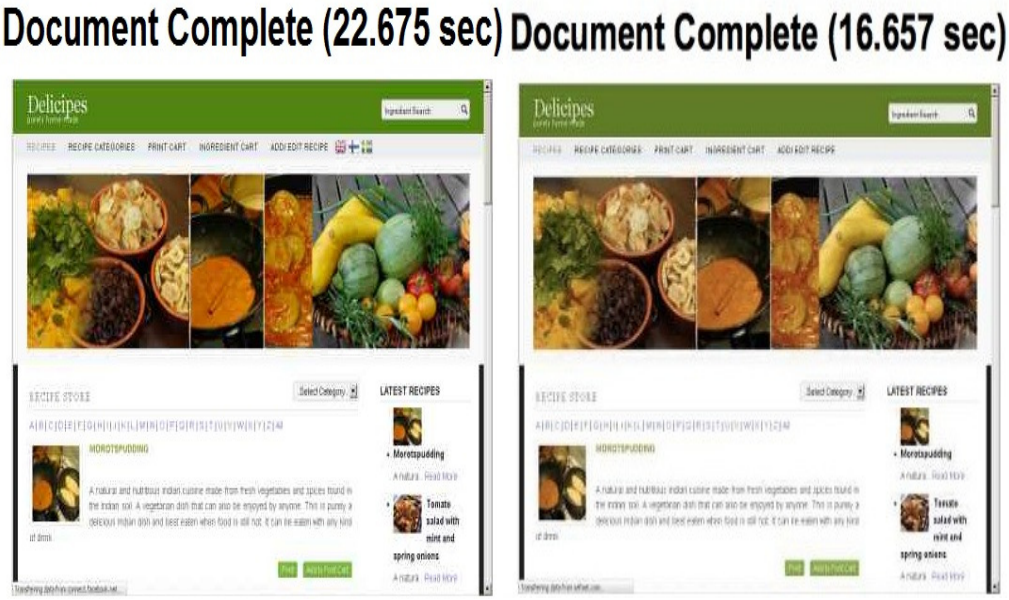

Figure 24: fully rendered application and time taken to complete

Looking back at the rendering time in figure 23, Windows system has the shortest time to start rendering but after the website was fully loaded in figure 24 the time taken to complete the process in Windows is a bit more than on the Mac system.

Figure 25 shows the outcome of results of figure 22. All the items except one passed the test and the reason for the failure is given in the comment column.

Action	Expected Result	Pass	Fail	N/A	Comments
Main Page Testing					
Search for recipe name by clicking on the alphabet	Displays recipe(s) names starting with the click alphabet	X			
If selected alphabet does not have any recipe	Display no such recipe is available	X			
Click on a recipe image	Shows detailed recipe with ingredients and cooking instructions	X			
Click on a recipe name	Shows detailed recipe with ingredients and cooking instructions	X			
Click on print button	Pop up window showing detailes of the recipe to be printed	X			
Click add to print cart button	Pop up alert window with "successfully added" as text	X			
Click **OK** from alert window	Add to cart button text changes to Added to cart and recipe is sent to print cart	X			
Add the same recipe to print cart	The button should be disabled because it has already been added	X			
Select recipe category from the drop down at the top	Should display recipe(s) under such category if any	X			
Search for recipe by ingredient from the top right search bar	Should display recipe(s) with such ingredient if any	X			
Click on the Swedish flag at the top right	Language of content should switch to Swedish	X			
Click on the Finnish flag at the top right	Language of content should switch to Finnish	X			
Click on the image of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Read More of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Recipe Name of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the image of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Recipe Name of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the image of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Recipe Name of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Scroll down to button of page and click Next	Displays the next 10 set of recipes	X			
Scroll down to button of page and click End	Displays the last set of recipes	X			
Testing Recipe Categories page					
Click on a category image	Shows all recipe(s) of such category	X			
Click on a recipe category name	Shows all recipe(s) of such category	X			
Click on Sub Categories text	Displays sub categories of the main category	X			
Click on print button	Pop up window showing detailes of the recipe to be printed	X			
Click add to print cart button	Pop up alert window with "successfully added" as text	X			
Click **OK** from alert window	Add to cart button text changes to Added to cart and recipe is sent to print cart	X			
Add the same recipe to print cart	The button should be disabled because it has already been added	X			
If recipe has been added to print cart from the main page	Add to print cart button should be disabled because it has already been added	X			
Search for recipe by ingredient from the top right search bar	Should display recipe(s) with such ingredient if any	X			
Click on the Swedish flag at the top right	Language of content should switch to Swedish	X			
Click on the Finnish flag at the top right	Language of content should switch to Finnish	X			
Click on the image of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Read More of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Recipe Name of latest recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the image of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Recipe Name of Most Hitted recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the image of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Click on the Recipe Name of Most Printed recipe module on far right	Displays details of that recipe (ingredients and cooking instructions)	X			
Select number of categories to display from display drop box at buttc	Display number of categories base on selected number		X		Does not work

Figure 25: results of test cases

The last item in figure 25 did not pass the test and the reason is written in the comment column. Every failed item is sent back to the project backlog for redesign.

7 Conclusion

The main goal of the thesis was to develop a web application that converts the traditional method of studying and cooking into an electronic form. This is to allow the teacher to easily put content into the database so that students can access them at any given time. The content may include texts, images and videos. Users will with just a click select ingredients of recipes into a shopping cart or be able to print multiple cooking instructions by selecting them. The application will be available to anyone connected to the internet.

Electronic teaching and learning methods have faced a lot of criticism. Some people argue that it does not bring the best out of a student; information is always available on the internet so time is not spent to study but rather to surf for solutions. To some, E-teaching is not sustainable and cannot entirely replace the old traditional way of learning.

E-teaching has over the years gained much recognition and some educational institutions have implemented it partially to some courses in their curriculum. It has been welcomed by the majority of people who work full time and still want to study. It cuts across distance and time and everyone can have access to the available content. All a user needs is a personal computer and a connected internet.

One challenge of the thesis was whether the quality of electronic teaching and learning system can match the traditional one. Based on the implementation of this project, I can say that the website application goes beyond what was earlier practiced. The project was successful and has given a stress free flow of how the knowledge of cooking is transferred from the teacher to the student. It has now become easy for the teacher to create and maintain content at any given time. E-teaching method is here to stay and with the increasing growth in technology, more sophisticated approach will be discovered.

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