SEWOS: Bringing Semantics into Web operating System

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ABSTRACT: **The revolution in web world led to increasing users' needs, demands and expectations. By the time, those needs developed starting from ordinary static pages, moving on to fully dynamic ones and reaching the need for services and applications to be available on the web!.. Those demands changed the perspective of our web today to what's said to be a cloud of computing that aims mainly to provide applications as services for web user. As time goes by, applications were just not enough; users needed their applications and data available anytime, anywhere. For these reasons, traditional operating system functionality was needed to be provided as a service that integrates several applications together with user's data.**
In this paper we present the detailed description, implementation and evaluation of SEWOS [1]- a semantically enhanced web operating system- that provides the feel, look and mimic traditional desktop applications using desktop metaphor.

Keywords: **Web Operating System, Semantic, Ontology, Service Oriented Architecture.**

1. INTRODUCTION

The World Wide Web has become a major delivery platform for a variety of complex and sophisticated applications in several domains. In this context, researchers investigated the ability to extend traditional web-based applications' functionality` to enable users to interact with applications in much the same way as they do with desktop applications. Web operating systems were developed to provide users with an environment that pretty much resembles traditional desktop environment through web browser. They represent an advance in web utilities as they aim to provide better operational environments by moving users' working environment within web site including managing his/her files, installing his applications. Web operating system can be defined as a virtual desktop on the web, accessible via a browser as an interface designed to look like traditional operating system with multiple integrated built-in applications that allow user to easily manage and organize his data from any location[2]. Web operating system provides users with traditional operating system applications as services available for user to access transparently without any prior knowledge about where service is available, the cost or constraints [3]. In web operating system, applications, data files, configurations, settings and access privileges reside remotely over network as services accessed by web browser which is used for input and display purposes [4].

As previously stated, web operating system – though its novelty - has drawn attention and many attempts have been made. WOS [3-9], the first known web-based operating system that provided a platform that enabled user to benefit from computational potential of the web. WOS provided users with plenty of tools through using a virtual desktop using the notion of distributed computing by replicating its services between multiple interacting nodes to manipulate user requests. WOS consists of three major components, graphical user interface, resource control unit which processes user request and finally a remote resource control unit which manages requests passed from other nodes.

The interest in web operating systems and their applications on academic communities resulted in VNet which was developed at the University of Houston and considered an access point to campus resources. VNet included variety of services that support students such as Desktop, admin management, contact management, file management services, calendar and scheduling services, report generation services, … etc [10].

Based on the earlier work of WOS WEBRES was developed. WEBRES investigated the aspects of resource sharing that wasn't addresses in WOS and presented the notion of resource set which makes resources persistent rather that bounded to a specific user[11].

G.H.O.S.T (http://g.ho.st/vc.html), EyeOS "www.eyeos.com" and DesktopTwo "www.desktoptwo.com " are examples of systems that were built based on the trends of web operating systems. They mimic the look, feel and functionality of the desktop environment of an operating system. Moreover, they present variety of applications such as: File management, Address book, Calendar and text editing applications.

Implementing such application requires considering user's requirements in all phases as the final evaluation requires user participation and intervention. This paper is organized as follows; the next section presents SEWOS general architecture. In section 3, implementation of SEWOS and applications is provided. In section 4 presents the evaluation of the proposed system. Our conclusion and future work is presented in section 5.

2. THE PROPOSED ARCHITECTURE

Web operating systems as previously mentioned has the features and functionality of traditional desktop operating system. However, Web operating systems typically transfer applications to web server where user can manage his resources through virtual desktop using web browser. At the start of our research we had three main interests which we tried to satisfy.

1- Moving from fully personalized familiar desktop on PC to a virtual remote desktop, is a hard task, as users will accept nothing less than traditional desktop which they have been accustomed to. Thus, user data, preferences as well as sessions must be maintained ensuring that user will always has a personal experience that resembles his fully personalized traditional pc environment.

2- Semantic web technology plays a significant role in today's web as well as desktop systems [18-19]. That's why we thought that it was only a matter of time before semantic web techniques thrust in the research of web operating system.

3- A service-oriented architecture (SOA) is seen as the next evolutionary step in building web-based applications as it provides a set of principles of governing concepts used during phases of systems development. As in n-tier architectures SOA separates presentation/applications, services and data into layers preventing dependency between layers.

In our work, we tried to merge the semantic web with web operating system utilizing the notion of SOA to support our architecture.

2.1 SEWOS ARCHITECTURE

SEWOS is SOA-based architecture that shows the underlying semantic file system of our semantic web operating system. SEWOS consists mainly of three layers, application layer, service layer and data layer as depicted in Figure 1. SEWOS architecture Application layer contains both user interface (portal) and application manager which in turn includes set of applications: file manager, word processing, spread sheets, web search and to-do list.

The second layer is service layer which includes transaction manager as well as personalization manager. Transaction manager controls user requests and works in correlation with both application layer and data layer in order to provide a virtual desktop. Personalization manager is responsible for generating a personalized desktop making use of user log, preferences and profile. Resource locator is used to locate where resources reside. Our architecture uses the notion of hybrid systems as it maintains a centralized resource location whereas resources themselves are decentralized. And finally, data layer contains back end databases that stores user profile, log file as well as user resources that are typical user files annotated using ontology.The next section embraces SEWOS implementation process.
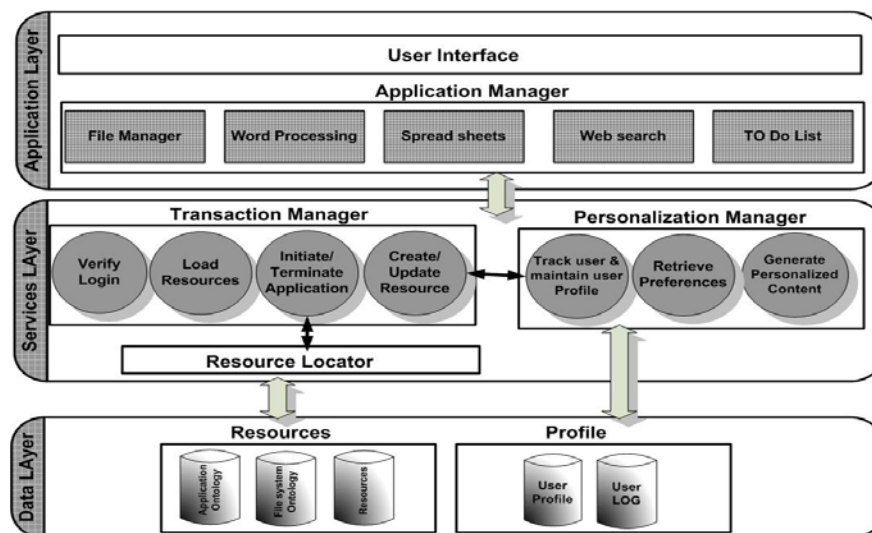

Fig.1 SEWOS Architecture

3. SYSTEM IMPLEMENTATION

SEWOS was developed based on SOA techniques. First, user must go through a registration process or an ordinary login for registered users. Afterwards, user will be able to view his personalized desktop, access and manage his own resources and applications. SEWOS makes use of memorization as a personalization function, displaying a welcome message and a fills user's personalized start

menu with his recent file list, his events, his favorite resources and applications. Besides his start menu, user can start any application directly using application icon on his desktop. Moreover, user can start and deal with multiple applications at the same time. Options to manage workspace preferences are also available and accessible through personalized desktop.

The implementation of SEWOS home page and personalized desktop is shown in Fig 2.

System's home page in Fig.8.a contains:

1- **Welcome message/Log out:** system identifies user and displays a welcome message as an application to aforementioned salutation personalization function. The system also gives user the ability to log off at any time during navigation.

2- **Personalized work space:** this includes user's personalized background, calendar and clock. User can choose to display clock, calendar or not and he can choose his own background using preferences dialog.

3- **Personalized start menu:** User's start menus includes four tabs as follows:
   1- **Recent tab:** This tab contains a list of user's personalized book-marking displaying a set of resources that were accessed during user's last visit.
   2- **Events tab:** This tab contains a list of user's events that are associated with today's date.
   3- **Favorite Files tab:** this tab contains a list of ranked files that are favorably accessed by user during that time of the day.
   4- **Favorite Applications tab:** Contains a list of SEWOS applications that are accessed by user during this time of the day.

4- **User Calendar and analog clock:** those two tools are added to user work space and can be hidden/ shown based on user preferences.

In the next section a detailed description of SEWOS's embedded applications, interface description…etc.
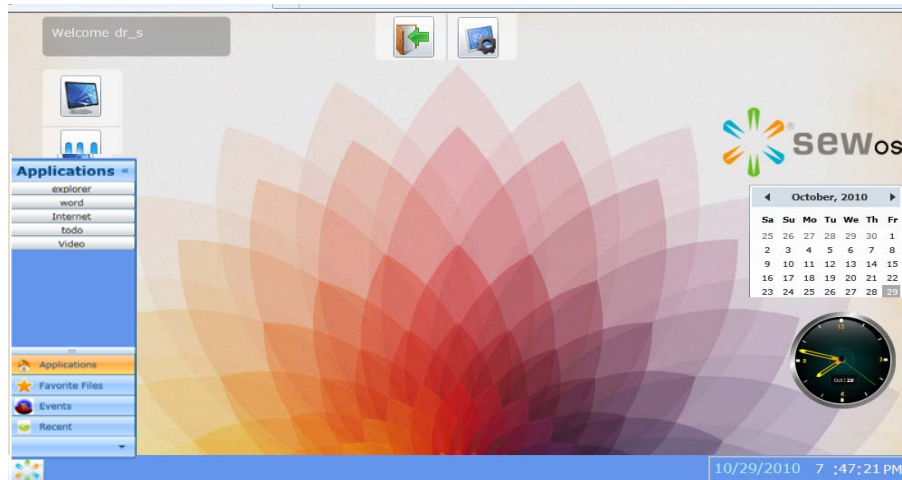

Fig.2. SWOS personalized Desktop

3.1 SEWOS FILE MANAGER

SEWOS file manager is a tool developed mainly to manage user's resources, this tool deals with resources and explores interrelationships for better processing. File manager interface and recycle bin are be shown in fig.3 the main components are:

1- **Navigational tree:** This tree loads user's folders and arranges them in a hierarchal form to facilitate user navigating.

2- **Item viewer:** This Viewer is used to display user's folders as well as files. Used to access folders and enables user to select files for further processing.

3- **Recommendations:** System provides user with three recommended lists upon any

resource's selection in the viewer pane. These lists are as follows:

a) **Accessed together list:** this list displays a list of ranked resources that are frequently accessed together with the selected resource during same sessions.

b) **Same Type/same creation date list:** This list displays a list of related files based on their type and related folders based on their creation date.

c) **Related content List:** this list displays a set of resources ranked according the degree of content relevancy between each resource and the selected resource.

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4- **Function Buttons:** File manager has capabilities to create new folder, upload/download and delete resource.

As previously stated, this manager's functionality is incomplete unless there exists a way for user to restore his deleted files. This includes having a personalized recycle bin which we consider as a main part of SEWOS File system. This is described in the next section.

3.1.1 SEWOS RECYCLE BIN

SEWOS Recycle bin completes the functionality of the underlying file system by acting as intermediate storage space for user's resources before they can be permanently deleted from the system. Recycle bin includes options either to restore deleted resource or to delete it permanently from system.

3.2 SEWOS TEXT EDITOR

SEWOS Text editor enables creating, viewing, editing, formatting, annotating, printing and saving text files. The application interface can be shown in Fig.4, this contains:

1) **Clipboard section**
   This section includes buttons that provides the basic copy, cut and paste functions.
2) **Font section**
   This section includes buttons that provides the main formatting options. This includes changing fonts, font size, color and alignment of the selected text.
3) **Insert section**

This section includes the basic options to insert pictures, tables and hyperlinks within text.

4) **File operations section**
   This section includes buttons that enables:
   - Creating new document.
   - Opening an existing document with extensions (.txt, .sav and .docx).
   - Saving user's documents to user's space with an extension (.sav).
   - Print preview of user document.
   - Printing user's document to user's printer.
   - Displaying XML code behind document authoring.

3.3 SEWOS WEB BROWSER AND SEARCH APPLICATION

Navigating the web is one of the main activities of almost every computer users, that's why SEWOS includes this application. Application's interface pretty much resembles the basic interface of web browser. With an address bar to write required URL and Go button to navigate directly to it. This application includes as well an interface to our developed personalized semantic search engine (PSSE) using a search button. Web browser and search application are both shown in Fig.5 (a, b).
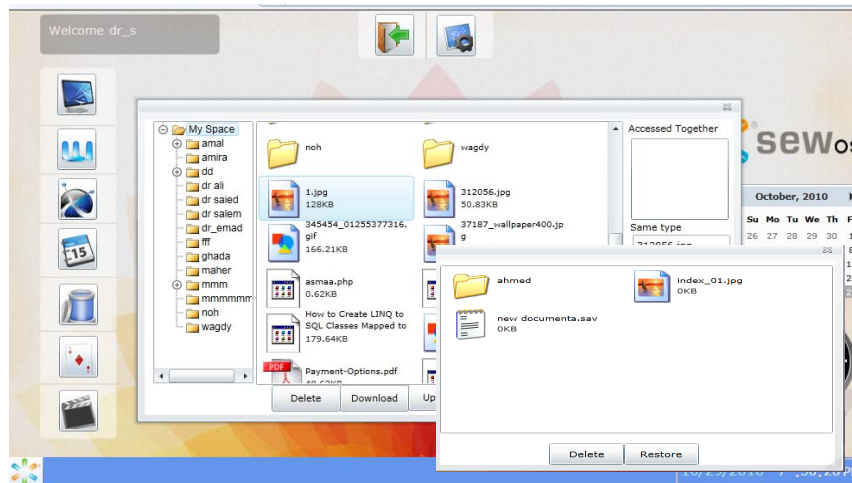

Fig.3 SEWOS File Manager and Recycle Bin

3.4 SEWOS CALENDAR

User's schedules and events are required to form user's every day to-do list, SEWOS calendar allows user to add his events and schedules for later retrieval. Important event are retrieved when user first logs into the system while related and similar events during

the current week can be displayed through Calendar application. SEWOS calendar includes displaying, adding and deleting applications as shown in Fig.6.

3.5 SEWOS VIDEO PLAYER

For their significance, multimedia files constitute huge part of today's web and user's resources. This tool is intended to provide user a way to open and view his multimedia files including both audio and video. Application's

interface as depicted in Fig.8 includes an open button, voice control section, play/pause button and two recommendation lists. Those lists retrieve resources related by both type and content
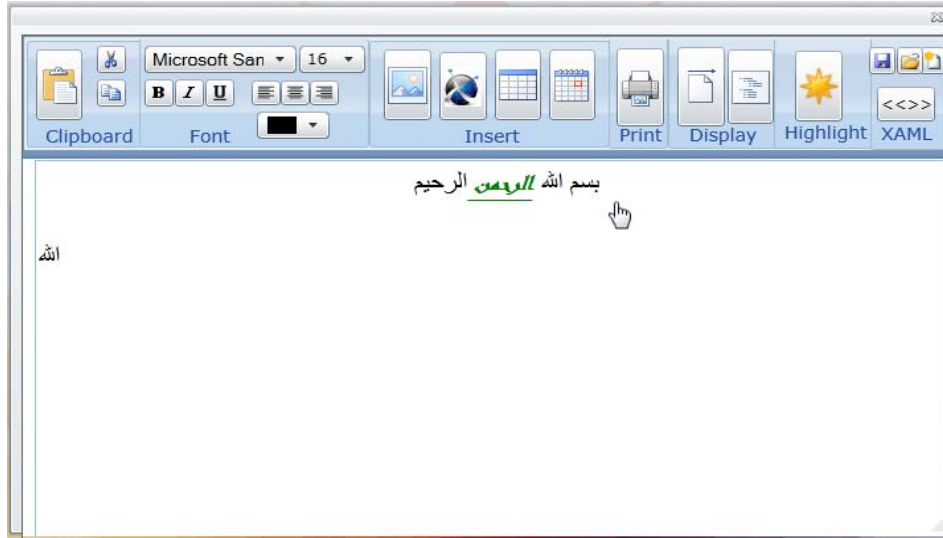

Fig.4 SEWOS Text Editor

3.6 SEWOS GAMING

Gaming and entertainments gain importance to user during his breaks and leisure times. SEWOS has a

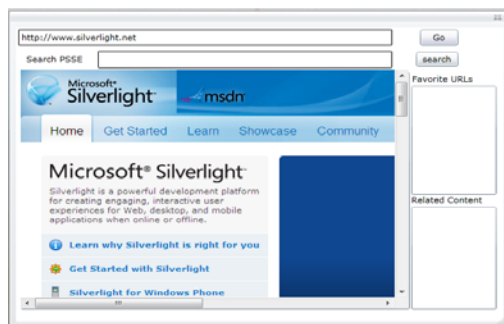built-in gaming application for the sake of user's entertainment. This application is shown in Fig.8.
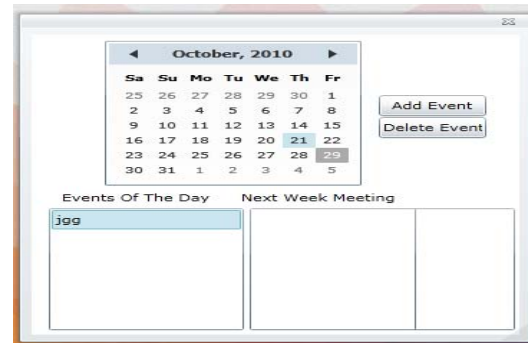

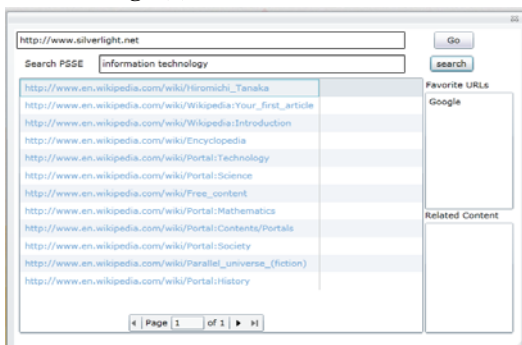**Fig.5(a) SEWOS Web Browser**

Fig.6 SEWOS Calendar

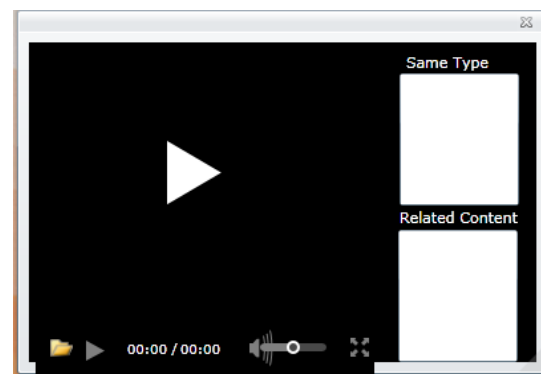**Fig.5(b) SEWOS Web Search (PSSE)**
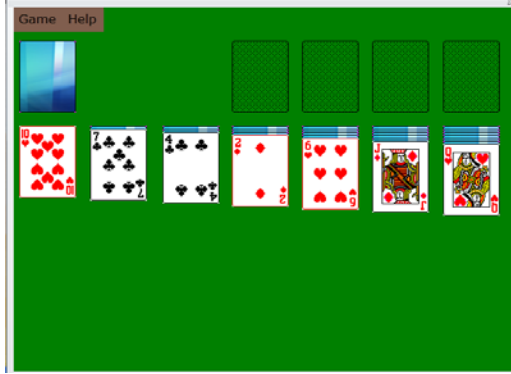

Fig.7 SEWOS Video Player

Fig.8 SEWOS Gaming

4. SEWOS EVALUATION

Many aspects of usability can best be studied by simply asking users. This is especially true for issues related to users' subjective satisfaction and possible anxieties. Since the system is highly dependent on user participation, the design team from the beginning has taken steps in collecting and analyzing user feedback. Evaluation of the system has been from the beginning an integral part of our Participatory Design implementation. For this sake, a questionnaire was provided for collecting feedback about the general usability of the system as well as user satisfaction about each of the embedded applications. Secondly, standard evaluation measures for information retrieval techniques were used to evaluate the performance of our proposed personalized semantic search engine (PSSE).

4.1 QUESTIONNAIRE

Twenty five experienced users responded to the questionnaire assessing the overall usability of the system. Questionnaire consists of forty four usability questions to which the respondent was to evaluate based on a five point likert-scale, ranging from 1 to – 5(represent from 20% to 100% satisfaction). Questionnaire was divided into seven main categories that represent assessment for each of the individual applications embedded in the proposed system, in addition to a section for users' suggestions and comments. The data responses to the questionnaires were entered in a spreadsheet, analyzed and descriptive statistical analyses were performed. After careful investigation of data, we can assure that the overall satisfaction of the participants with system was high. Frequencies were analyzed to show that 76% of users were 100% satisfied with SEWOS functionality; whereas 16% were 80% satisfied and only 8% were 60% satisfied about the system. For SEWOS file manager, it gained 100% satisfaction of 64% of the participants, 80% by 20% of the participants and 16% were 60% satisfied. For the rest of the statistics, Table 1 includes the percentage of

participants for SEWOS and applications based on the available scales.

	100%	80%	60%	40%	20%
SEWOS Functionality	76%	16%	8%	0%	0%
SEWOS File Manager	64%	20%	16%	0%	0%
SEWOS Text Editor	72%	20%	8%	0%	0%
SEWOS web browser	76%	16%	8%	0%	0%
SEWOS Calendar	88%	12%	0%	0%	0%
SEWOS Video	72%	16%	12%	0%	0%
SEWOS gaming	56%	24%	4%	0%	0%

Table 1: Percentage of users votes with respect to each scale

Comments reflected a desire for adding more applications that both help desktop and web activities, improvement of the capabilities of the system by adding context menus and more visual aids.

A graphical representation of the overall ratings for all categories is provided in Figure 9. The former evaluation for our system depended on measuring user satisfaction of SEWOS and applications usability.
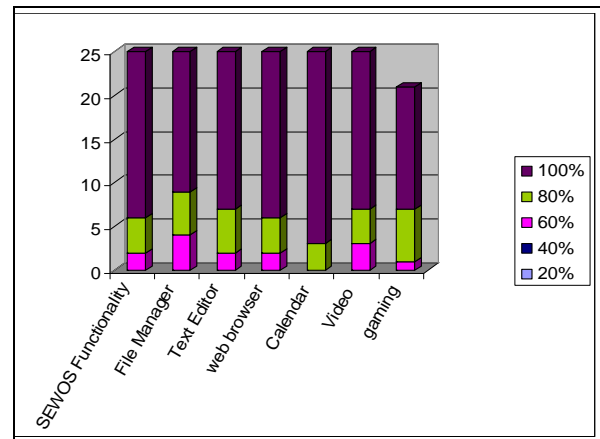

Fig.9: Plot of users ratings for SEWOS and Applications

5. CONCLUSION AND FUTURE WORK

Gaining users' satisfaction was our main goal and motivation when developing SEWOS. Now, after statistical analysis of participants' ratings, we can say that impressions from the evaluation of our data were in favor of our proposed system. Our future work includes providing large-scale evaluation of SEWOS as well as investigating users' feedback and provides more applications that better suits SEWOS users' need. Moreover, we'll try to provide integration between SEWOS and services available on the World Wide Web.

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