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Haverstock et al.

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(54) **WEB SERVER WITH UNIQUE IDENTIFICATION OF LINKED OBJECTS**

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**[7] **G06F 15/16**; G06F 15/167

(52) **U.S. Cl.** **709/219**; 709/202; 709/203; 709/206; 709/217; 709/246

(58) **Field of Search** 717/10, 8, 513; 709/218, 246, 203, 206, 207, 202, 217, 219

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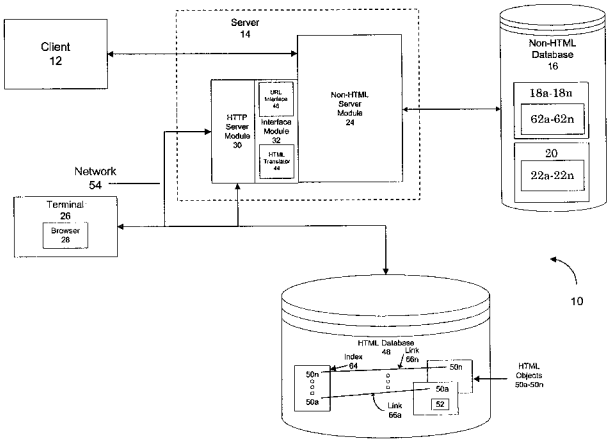
(57) **ABSTRACT**

A system for enabling access to non-HTML objects from a web browser. The system includes a database for storing non-HTML objects. A system user requests a non-HTML object from a database using a web browser. The web browser transmits the request to a server via a HTTP server and module. The server locates and retrieves the document requested. The module translates the document to a format supported by the web browser. The HTTP server communicates the translated object to the web browser over a network. The web browser then presents the translated object to the system user. The system also provides documents with a unique identifier. Once a unique identifier is assigned to a document, the system refers to the document by the unique identifier.

19 Claims, 3 Drawing Sheets



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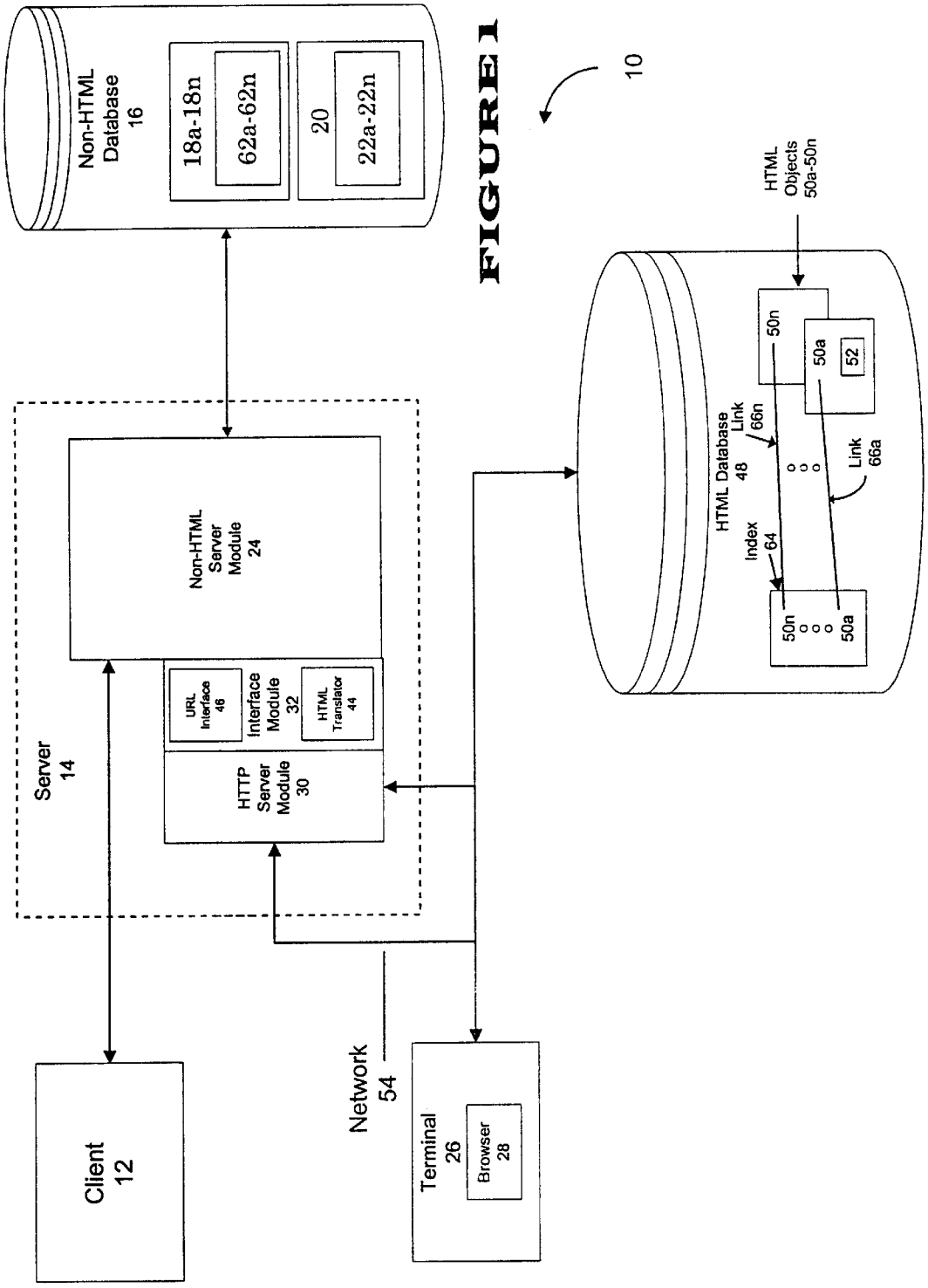
Non-HTML Database 16
18a-18n
62a-62n
20
22a-22n
10
HTML Objects 50a-50n
Server 14
Non-HTML Server Module 24
URL Interface 46
Interface Module 32
HTML Translator 44
HTTP Server Module 30
HTML Database 48
Link 66n
Link 66a
Index 64
50n
50a
52
Client 12
Network 54
Terminal 26
Browser 28

FIGURE 1

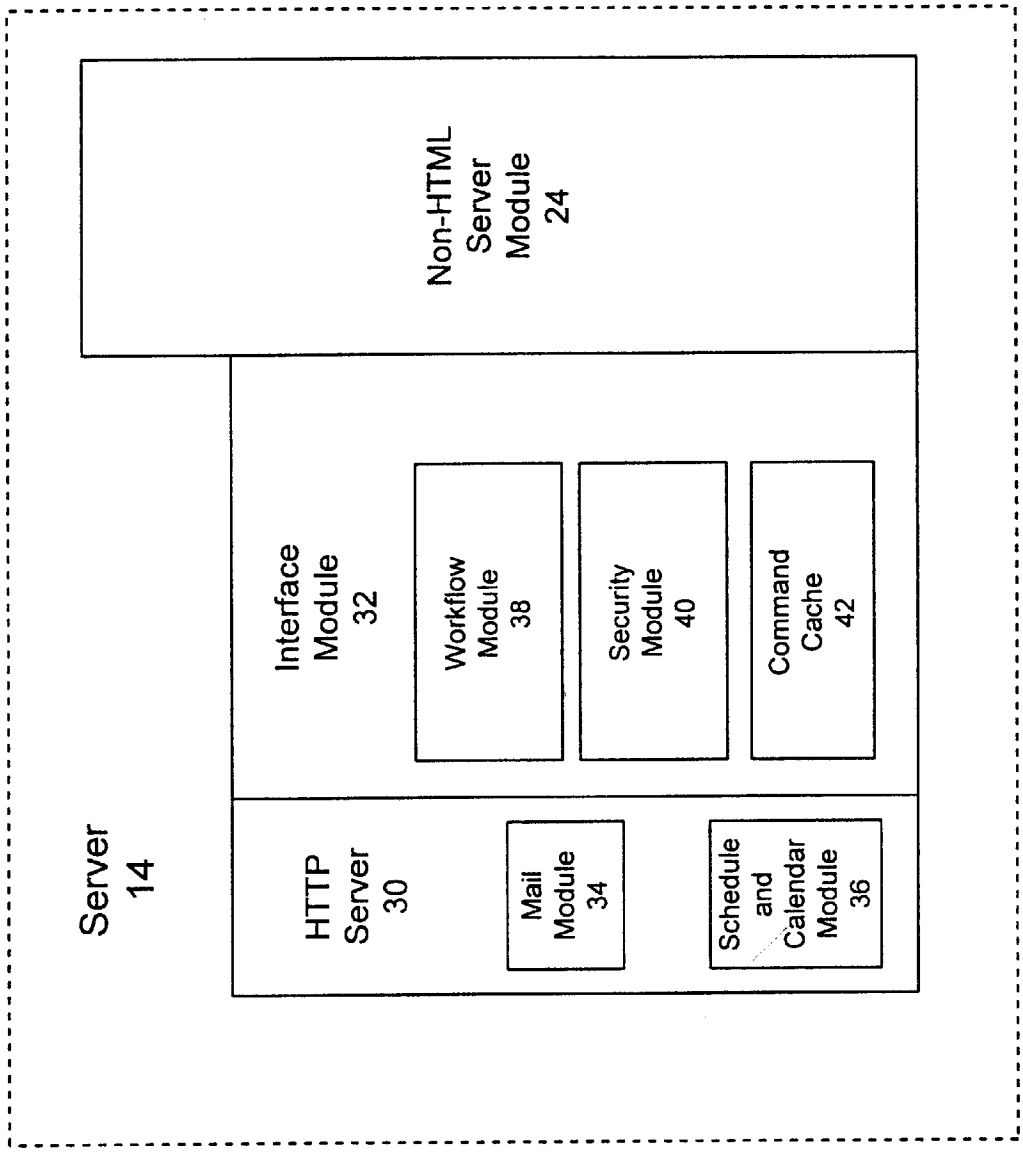
Server
14
HTTP
Server
30
Mail
Module
34
Schedule
and
Calendar
Module
36
Interface
Module
32
Workflow
Module
38
Security
Module
40
Command
Cache
42
Non-HTML
Server
Module
24

Figure 2

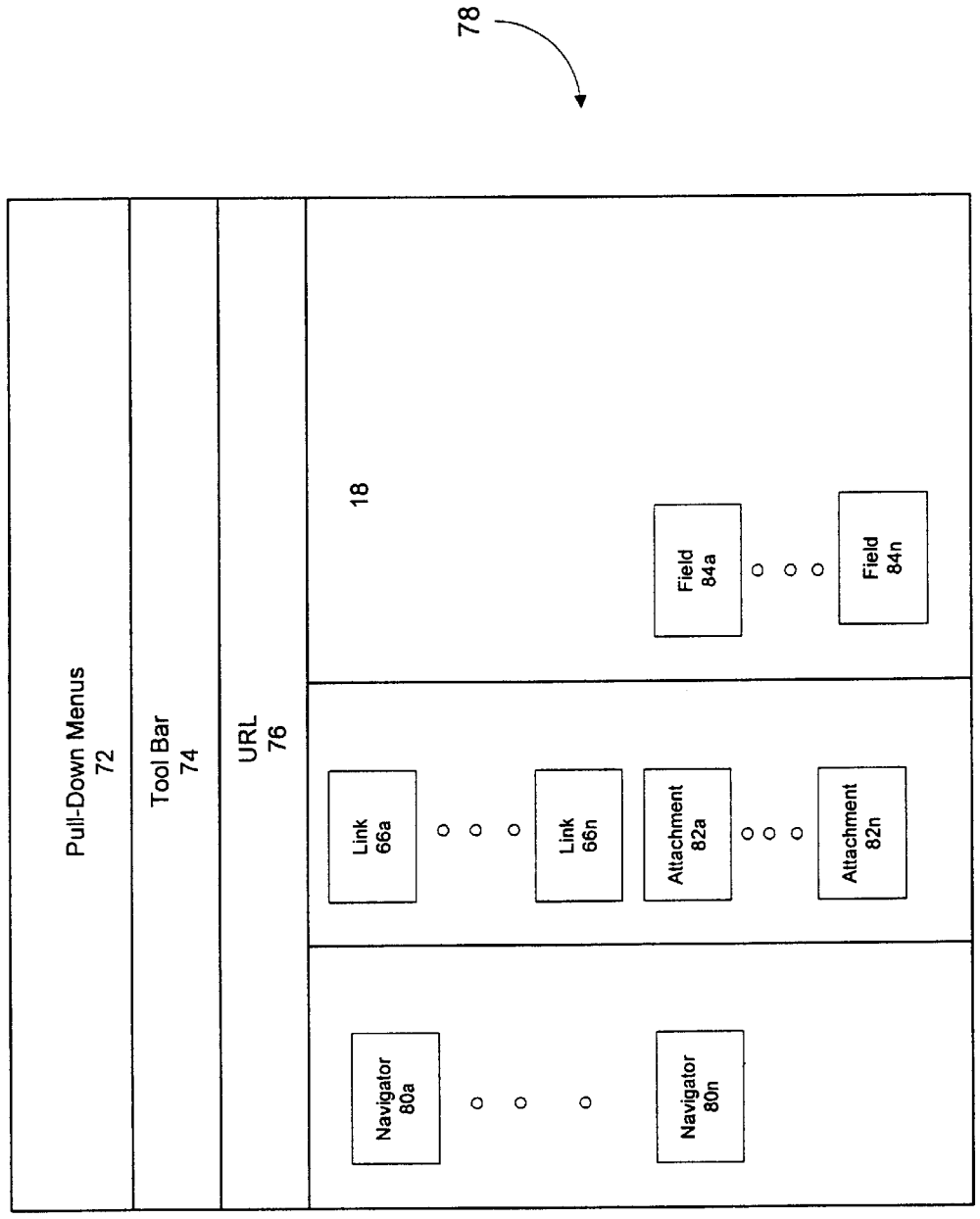
78
Pull-Down Menus
72
Tool Bar
74
URL
76
18
Navigator
80a
Navigator
80n
Link
66a
Link
66n
Attachment
82a
Attachment
82n
Field
84a
Field
84n

Figure 3

WEB SERVER WITH UNIQUE IDENTIFICATION OF LINKED OBJECTS

RELATED APPLICATIONS

This application claims priority based on U.S. Provisional Patent Application Ser. No. 60/050,153, entitled "Web Server Application" filed Jun. 19, 1997. This application is also related to co-pending U.S. Patent Applications entitled, "Web Server Enabling Browser Access to HTML and Non-HTML Documents," Ser. No. 09/100,131, filed herewith, "Web Server With Direct Mail Capability," Ser. No. 09/100,130, filed herewith, "Web Server With Automated Workflow," Ser. No. 09/100,129 , filed herewith, "Web Server Providing Role-Based Multi-level Security," Ser. No. 09/100,128, filed herewith, "Web Server With Ability To Process URL With Action Commands," Ser. No. 09/100,117, filed herewith, "Web Server With Integrated Scheduling and Calendaring," Ser. No. 09/100,119 filed herewith, "Web Server Providing HTML Pages Embedded With Non-HTML Views," Ser. No. 09/100,120, filed herewith, and "Web Server Enabling Attachment of HTML and Non-HTML Files To Web Pages," Ser. No. 09/100,121, filed herewith.

FIELD OF THE INVENTION

The invention relates to a web server that employs unique identification of linked objects.

BACKGROUND OF THE INVENTION

Web browsers such as Netscape Navigator and Microsoft Internet Explorer are well known. Web browsers are software residing on a client (e.g., a personal computer). Via the browser, the client can communicate with a web server to enable access to and viewing of Hypertext Markup Language (HTML) documents. A web server typically includes a server (e.g., a UNIX- or Windows NT-based computer) connected to a network (e.g., the Internet, an intranet or other network), web server software configured with the host name of the server and the location of HTML objects on the servers and the HTML objects stored by that server.

In general operation, to access a web page, a user enters a request by specifying a uniform resource locator (URL) via the browser and hitting "Submit" (or another function key) and the URL is sent to the web server using HTTP. The web server responds by locating the requested HTML document and returning it to the browser. The browser receives the HTML document, interprets the HTML codes, translates them into a web page, and displays the web page. In this way, web browsers enable access to the vast number of HTML documents via the World Wide Web, the Internet or intranets. HTML generally is well known. A primary purpose of HTML is to describe how to format the text (and other content) of a web page. HTML uses tags to indicate how text of a web page should be displayed and to specify the URL of objects to which a page is linked. HTML objects are commonly stored on a web server as standard text files with a HTM or HTML extension. Linking is a powerful feature of HTML. One drawback with HTML links is that links are created by coding a page with HTML tags to link it to other objects (e.g., another document or a specific location within a document). Therefore creating web pages and links requires a working knowledge of HTML and the time required to write HTML code a create a page and any desired links. Editing an HTML page or a link typically requires using HTML to edit the original web page or link. One significant problem with HTML links is that if a web page (or other object is linked to it) is moved or deleted any links to that page or object needs to be manually changed or a "file not found" message will appear when a user clicks on the link.

One limitation of web browsers and web servers is that they were designed primarily to access HTML documents. Browsers typically cannot cause a web server to retrieve and return non-HTML documents. This inhibits a user from accessing non-HTML documents, objects or databases from a web browser. Non-HTML objects, for example, may include non-HTML documents, stored views for documents in a database, identification files stored in a user directory and many other types of objects. Views provide a convenient way to index a plurality of documents. Identification files may comprise information about a system user (e.g., electronic mail address, role, profile, etc.).

A common problem with HTML linked pages is that if the name or location of a page changes, the link to it must be re-coded. Otherwise an attempt to link to that page will return an error message, such as "Page Not Found." Another drawback is that if a user creates an index of pages, with a link to each page, to add a new page the user must modify the HTML code.

Other drawbacks exist.

SUMMARY OF THE INVENTION

One object of the invention is to overcome these and other drawbacks present in existing systems.

Another object of the invention is to provide a web server that can respond to requests from a web browser for either HTML or non-HTML documents and return the requested documents to the web browser.

Another object of the invention is to provide a system that enables linked documents to have a unique identifier, with the link referring to the identifier to avoid errors if a page is renamed or moved.

Another object of the invention is to provide a system that enables automatic link updating when new documents or links are created within a system.

According to one embodiment of the invention, the system comprises a novel web server for a client/server network, where the client side is equipped with a standard browser. The server comprises standard web server functionality (e.g., HTTP server), an HTML translator, a server side software (e.g., Lotus Notes server software) and a database (e.g., a Lotus Notes database). Significantly, the database does not need HTML objects. Preferably, the server receives a URL-based request from a browser via HTTP, the HTTP server and HTML translator determine the object (e.g., documents or databases) specified by the URL, retrieves that object, translates that object to HTML format and sends the HTML downloaded object to the client side browser for display.

According to another aspect of the invention, the system provides a unique identifier to documents within the system. After the system assigns a unique identifier, the system refers to the document by the unique identifier This provides several advantages, for example, link management. If a link is referred to by filename or location, and the filename or location is changed, the system will be unable to locate the object. Because the system uses a unique identifier which does not change for a given document, the links are maintained.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating an overall system in accordance with one embodiment of the invention.

FIG. **2** is a block diagram illustrating an interface module in accordance with one embodiment of the invention.

FIG. **3** is a view of a display in accordance with one embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As schematically illustrated in the block diagram of FIG. **1**, one aspect of the invention relates to a client/server network system **10** enabling access to both HTML objects **50***a*–**50***n* (e.g., HTML documents) and non-HTML objects **18***a*–**18***n* using a web browser **28** residing on a terminal **26**. Preferably, web browser **28** supports Internet and Web protocols (e.g., HyperText Transfer Protocol (HTTP) and TCP/IP). The system may further comprise a client **12** to enable a non-browser client access to non-HTML server module **24** to retrieve non-HTML objects **18***a*–**18***n* from non-HTML database **16**.

A server **14** preferably comprises a HTTP server module **30**, interface module **32** and non-HTML server module **24**. As further illustrated in FIG. **1**, the server side of system **10** may comprise a non-HTML database **16** in communication with server **14**. Preferably, non-HTML database **16** stores one or more non-HTML objects **18***a*–**18***n*, each at least some of which having one or more non-HTML fields **62***a*–**62***n*, and a user directory **20**. User directory **20** includes one or more user objects **22***a***22***n*. User objects **22***a*–**22***n* may include information about a user (e.g., electronic mail address, role, profile, etc.). Terminal **26** and server **14** can be in communication via a network **54** (e.g., Internet, Intranet or other network).

According to one aspect of the invention, a user submits a URL-based request for an object via browser **28**. The request is passed to server **14** using HTTP (or other protocol). Server **14** receives the request via HTTP server module **30** and passes object location information to interface module **32** via URL interface **46**. URL interface **46** transmits that information to non-HTML server module **24**. Non-HTML server module **24** retrieves the requested object and passes it to interface module **32**. A HTML translator portion **44** of interface module **32** translates the non-HTML object to a HTML representation of the requested object and the HTML representation is returned to browser **28** via HTTP server module **30**.

System **10** also enables browser **28** to access HTML objects **50***a*–**50***n* using HTTP server **30** or a conventional web server **56** in a known manner. A conventional editor may be used to edit HTML objects within the system. A conventional technique (e.g., a computer gateway interface (CGI)) may be used to store the edited HTML objects in the HTML database.

Thus, one advantage of the invention is that server **14** enables a browser **28** to request both HTML objects **50***a*–**50***n* and non-HTML objects **18***a*–**18***n*. Additional advantages derive from this capability. For example, one significant advantage is that the invention exposes powerful resources available in non-HTML databases **16** to a web browser **28** according to one embodiment of the invention.

Preferably, the invention comprises a Lotus Notes server. Advantageously, even with this embodiment a standard browser-based client may be used. As detailed below, Lotus Notes provides the non-HTML server module **24** a rich set of services that has made it a leading messaging and groupware platform. By expressing Notes capabilities to the Web (using a browser) via the present invention, Web developers can take advantage of an architecture that integrates database, security, directory, messaging, workflow, replication, and application development technology in a single platform heretofore lacking in browser based systems using HTML objects.

Lotus Notes, for example, is a robust system offering many features (e.g., forms, views, navigators, agents, folders, etc.). These resources in general are known, however, the ability to expose the features to a web browser is accomplished according to one aspect of the invention. Because Lotus Notes provides these and other features, Notes will be used to illustrate how features of a non-HTML database may be exposed to a web browser using the invention. Although Lotus Notes is used by way of example, the invention may be used with other non-HTML databases.

One advantage of the invention is that it enables browser **28** access to non-HTML objects (e.g., user objects **22***a*–**22***n*) via a non-HTML server module **24**. Through communication with the non-HTML server module **24**, browser **28** is provided with additional functionality (i.e., functions supported by non-HTML server module). For example, non-HTML server module may comprise a security module. Because browser **28** retrieves non-HTML objects using non-HTML server module **24**, the security module controls access to the non-HTML objects based on predetermined criteria. Therefore, this function is exposed to browsers.

For example, system **10** retrieves non-HTML objects **18***a*–**18***n* via non-HTML server module **24**. By communicating with non-HTML server module **24**, system **10** permits web browser **28** to utilize functions of non-HTML server module **24**. For example, a system user may access non-HTML objects **18** from non-HTML database **16** (e.g., a Lotus Notes database). When non-HTML object **18***a* is retrieved using non-HTML server module **24**, functions associated with non-HTML object **18***a* become available to the system user. For example, non-HTML object **18***a* may comprise an agent which transmits a message or facsimile notifying another system user that non-HTML object **18***a* has been accessed. The invention exposes this and other functions provided by non-HTML server modules **24** to browsers **28**.

The system may use a bidirectional replication process to ensure that all system users are accessing the most recent versions of HTML objects **50***a*–**50***n*. The replication process used is efficient because it is selective, can be scheduled, and can perform at the field-level. Selective replication enables administrators to replicate only a subset of data within the HTML database (for example, specific databases or HTML objects). Replication may be scheduled to run when networking costs are minimized. With field level replication, only those fields within HTML objects that are new or have been changed on either side of the replication process need to be replicated. With these sophisticated replication capabilities as a part of the infrastructure, developers can focus on creating Web applications which enable business processes within and across lines of business and corporate boundaries. The benefit to the user is easier manageability of databases and data integrity in all sites.

During replication, directory changes are also replicated, because the directory is simply another database in the invention, with the same structure and properties as a Web page library. Therefore, for example, discussion forums can be replicated, because discussions are simply another instance of a database.

As described above, links in HTML and non-HTML systems are well known. A HTML system may comprise a HTML database **48** comprising HTML objects **50***a*–**50***n*.

HTML objects **50***a*–**50***n* are stored using a user assigned filename. The system retrieves HTML objects **50***a*–**50***n* based on the filename. An index **64** identifies HTML objects **50***a*–**50***n* in HTML database **48** and provides links **66***a*–**66***n* to each HTML object **50***a*–**50***n*. HTML objects **50***a*–**50***n* may comprise links **66***a*–**66***n* to other HTML objects **50***a*–**50***n*.

A non-HTML database **16** (e.g., a Lotus Notes database), however, assigns a unique identifier to non-HTML objects **18***a*–**18***n* and indexes and retrieves non-HTML objects based on the unique identifier. When a file is created, for example, in a Notes database, a system user designates a filename. In addition to the filename, the system assigns a unique identifier to non-HTML objects **18***a*–**18***n* and automatically indexes non-HTML objects **18***a*–**18***n* in an index **64**. This technique improves link management. For example, if a user requests non-HTML object **18***a* by filename, the system uses the unique identifier to retrieve non-HTML object **18***a*. This reduces the likelihood of receiving a error message indicating, for example, "File Not Found" produced by prior systems if a filename has changed. Prior systems retrieve files by filename and thus may be unable to locate a non-HTML object **18***a* because a system user has input a previous filename. By assigning a unique identifier to non-HTML objects **50***a*–**50***n*, the system reduces the occurrence of such errors. The invention enables browser users access to functionality such as unique identification by permitting browser users access to non-HTML server modules. Once a browser accesses a non-HTML server module, many functions provided by the server module are exposed to the browser because the non-HTML server module communicates with the browser as if the browser is a non-HTML client.

Another advantage with unique identifiers is link updating. A non-HTML index records which non-HTML objects **18***a*–**18***n* refer to the other non-HTML objects in non-HTML database **16**. For example, a user creates a new document or edits an existing non-HTML object **18***a* and provides a link to non-HTML object **18***n*. The system identifies non-HTML object **18***n* with the unique identifier and automatically updates the index to reflect that non-HTML object **18***a* refers to non-HTML object **18***n* using a link. The invention exposes this and other functions provided by non-HTML server modules **24** to browsers **28**.

In addition to identifying non-HTML actions within a URL, system **10** also permits attaching non-HTML objects to HTML objects. For example, a user may attach non-HTML object **18***n* to HTML object **50***a*. Attaching files includes storing the attaching object (i.e., HTML object **50***a*) with the attachment (i.e. non-HTML object **18***a*). Additionally, a link is provided from HTML object **50***a* to non-HTML object **18***a*. The link is provided within HTML object **50***n*. The link identifies the location of the attachment stored with HTML object **50***n*. HTML objects may also be attached to non-HTML objects using the above process.

In addition to the above features, system **10** also provides other functions. For example, system **10** provides integrated mail application module **34** and scheduling and calendaring application module **36**. System **10** uses web browser **28** to permit reading, creating, editing, etc. of electronic mail messages and calendaring and scheduling of events. The calendaring and scheduling application module **36** permits the system user to invite other invitees to the event (e.g., system users, conference rooms, audio/visual equipment, etc.). For example, using the calendaring and scheduling feature, a system user schedules an event. The system user may then retrieve a form which serves as a template for creating an electronic mail message (e-mail). The e-mail is composed in cooperation with the scheduling application and therefore identifies information concerning the event (e.g., date, time, location, etc.). The system user addresses the e-mail to the invitees using electronic mail addresses stored in a user directory. The user directory may include additional information (e.g., user role, profile, etc.). The e-mail may be provided with a view inquiring whether the invitee accepts, declines, etc. If an invitee accepts, the system will automatically schedule the event in the invitee's calendar. The system user may also input additional information (e.g., textual information, attachments, etc.).

The messaging, calendaring and scheduling function are performed directly through the web browser. A separate window or application does not need to be opened. Prior browser-based systems require separate mail, schedule and calendar applications to be opened in a separate "windows."

One advantage of the server **14** of the present invention as compared with other Web servers is that it exploits the Web to handle the activity that is driven by the information that is posted on the Web site. Two core services of the invention that make this possible are messaging and workflow.

The server supports major industry messaging protocols and Application Programmer's Interfaces (APIs). The invention provides a backbone messaging platform with robust message transfer agents (MTAs) for SMTP, X.400, cc:Mail, and Notes Mail. Messaging services support e-mail clients using industry standards, including Post Office Protocol v3 (POP3) and Internet Mail Access Protocol v4 (IMAP4). The invention also supports other broadly deployed protocols, including Vendor Independent Mail (VIM), and Messaging API (MAPI).

The invention also includes group calendaring and scheduling functionality, and will support standard calendar and schedule protocols as they emerge.

The combination of messaging with calendaring and scheduling functionality provides developers with the tools to create Web applications incorporating workflow. Business processes that have time-sensitive actions and tasks associated with multiple users can be rapidly enabled. For example, a Web application can intelligently route messages and forms to users based on a variety of business relevant conditions (for example, user, schedule, time, priority). Also, a Web application can be designed to examine a group of users' calendars, determine the optimal schedule to ensure business processes are completed, and notify each user of impending work.

Company A can take advantage of this messaging and workflow functionality to enable a sophisticated set of processes for managing customer issues. Issue status requests may be routed to the appropriate Company A service representative based on a combination of parameters including the inquirer's company, his or her service level agreement, and the priority of the inquiry. The invention can efficiently handle non-routine occurrences such as re-routing messages destined for absent service representatives by examining their schedules. Also, issue status requests that exceed a specific time threshold can automatically trigger escalation to managers via e-mail or pager.

Workflow is a programmed application that performs one or more tasks according to a pre-defined process (e.g., using agents or macros). Workflow operates to automate, for example, administrator and end-user tasks upon the occurrence of a predetermined event (e.g., a browser request for a particular document, modifying a particular document, etc.). For example, a system user may create an expense

report for use by a company. Before the expense report may be used, however, it must be reviewed by a manager. Therefore, a process may be programmed into the server **14** in which all created expense reports are electronically mailed to a manager for review. Workflow may be applied to any document. For example, if a purchase order is created, the order may require from an accounting department. A process may be programmed into the server **14** to automatically mail the purchase order to personnel in the accounting department for approval. Other types of workflow may also be achieved, for example, transmitting an electronic mail message to a system user notifying the user that a document has been accessed, informing a manager that action is required on a particular document (e.g., a request for approval), etc.

As shown in FIG. **2**, system **10** may also comprise a workflow module **38**. Workflow module **38** distributes, routes and tracks documents according to a predefined process. For example, workflow module **38** may route documents to specific system users in a predetermined order. If a document must be reviewed by specific system users, workflow module **38** routes the document to the system users according to a routing process. If a system user does not act on the document before a predetermined time, workflow engine **38** may notify the system user that action is required, forward the document to another system user, or perform another action identified in the routing process.

Additional features of the invention include quick and easy development and deployment of documents by providing point and click extended HTML design for forms, tables, user interface controls, image maps, links and summary views, for example. The system also provides URL interface access to database servers, such as Lotus Notes®, for example. The system acts on background agents for workflow monitoring and provides templates and design replication for application update and delivery.

The system also allows system users to design features (e.g., databases, forms, views, etc.) in a visual integrated development environment (IDE) using a browser. For example, a system user may create an employment application form. The form comprises various fields requiring system user input. To facilitate the creation of this form, another form having similar fields (e.g., work history form) may be used. For example, the system user may display both forms using Web browser **28**. The work history form may have a field which the system user requires in the employment application form. To input the field from the work history form into the employment application form, the system user may simply select and "drag" the field (e.g., by using a conventional computer mouse) into the location in the employment application form and "drop" the field into the employment application form. Other known features of an integrated development environment may also be performed from a web browser due to the present invention.

For example, the Lotus Notes IDE provides developers with a forms-based metaphor that exploits the inventions object store, directory, security, workflow, and replication services. That is, developers using Notes have direct, programmatic access to these robust services, instead of resorting to limited interfaces between a scripting language and a set of services found in separate products and/or servers.

Moreover, the Notes development metaphor lends itself well to the types of business applications deployed on the Internet or on an intranet. For example, if a Notes designer client employs a set of intuitive and flexible application design elements (for example, forms, fields and views) that have great synergy with the page and link paradigms of the Web. Specifically, developers create forms and populate them with a variety of fields which interact with the user through agents, scripting language, and formulas. The layout and content of the form is automatically translated to HTML and delivered by the invention to the user for viewing in his or her Web browser. Once a form has been populated and saved, it is stored and processed as a page in the database, which can then be linked to other pages using the same hypertext linking mechanism so successfully exploited by the HTTP/HTML protocol set. The use of forms and fields lends itself to rapid application prototyping and development in at least three specific ways.

First, new views can be created on the fly. Because forms consist of fields, developers can sort pages based on the values of those fields on each page. For example, a Human Resources intranet application might include the ability to look up personnel information by first name, last name, department, manager, hire date, job level, etc. A sales management application might include the ability to sort all pages by customer, sales region, sales person, or revenue. If users request to see the information sorted a different way (for example, to sort all pages by social security number), all the developer has to do is create a view based on that field. All the links between all the pages are preserved.

Second, a single change in a form is inherited by all pages that use that form. Because pages in the database are based on a form, any changes to that form are automatically reflected on each page. This makes it easy to make global changes to some or all of the pages in the database. For example, if a company changes the logo it uses for one of its products, the developer simply deletes the old logo from all the forms that use it and replaces it with the new logo. Even if hundreds or thousands of pages use that graphic image, only one change has to be made. This is a vast improvement over Web authoring systems that treat each page independently, so that a single change has to be repeated on every page.

Third, forms are used to create templates, which serve as a rich baseline of functionality for customized applications. The invention includes predefined sets of templates for the most common types of Web applications: discussion forums, document libraries, project management, and review and approval applications. These templates include all of the logic and formatting required for a working application, and can be deployed with no changes. Developers can also add new fields and logic to these templates. These templates also extend basic application development capabilities to power users as well.

Another advantage of the Notes IDE is its ability to reuse application objects from other applications. Forms (or parts of forms) from one application can be reused in new applications. For example, a registration form used to collect leads over the Internet can also be used for an intranet training course application. Whereas the Internet registration form might ask for e-mail address, telephone and fax number, the training class registration form might ask for cost center information. Both forms could use the same template, and the same validation and routing logic. Furthermore, if a change is made to the original template, it is automatically inherited by all the other forms that are based on it. For example, if an employee number changes from four digits to five digits, it might require that the validation logic on the template be changed. Any other forms based on that template will automatically include the new logic as well, saving developers significant time and effort.

Collaboration sites handle the activity that occurs among people and the information that they handle. Typical collaborative activities include discussions and brainstorming, review and approval cycles, human resource employee reviews and candidate interview processes. The creation of most content is a collaborative process: creating a press release, white paper, or even a job posting normally involves more than one person. Providing customer service after a sale has been made is also a collaborative process that involves the customer and at least one other person inside a company. That is, collaboration is an integral activity that surrounds content and commerce. There is very little, if any, Web technology in place to effectively support collaboration.

One embodiment of the invention relates to a Web application server, its basic architecture and the integral services that lend themselves to the rapid development and deployment of collaborative applications that support content and commerce.

To realize these and other capabilities, server **14** may further comprise various modules as depicted in FIG. **2**. For example, HTTP server **30** may further comprise a mail application module **34** and a scheduling and calendaring application module **36**. Interface module **32** may further comprise a workflow module **38**, command cache **42** and a security module **40**.

The additional components shown in FIG. **2** enable various capabilities to be provided to enhance the advantages of the system. Each of these components and examples of the added capabilities is described below.

Unlike basic Web-based customer service applications, the invention workflow goes beyond the publishing of customer information to allow true customer-to-business interaction in which a specific business process is supported. For example, the advanced customer support system may be used to: initiate an inquiry, process the inquiry, assign the inquiry, notify the appropriate customer representative, and monitor the status of the inquiry.

Benefits of the invention range from minimizing the time and cost required to develop and deploy interactive Web applications, to actually achieving company goals that were once virtually impossible without the widespread use of the Internet.

There are several requirements of companies both large and small, regarding Web applications:

Interactivity. Much more than static HTML document delivery is required to enable interactive applications, especially in a supply chain management setting. The present invention provides the template forms and development tools to rapidly develop interactive applications.

Inter-enterprise connectivity. The most effective Web applications extend throughout a company's supply chain, from suppliers and business partners all the way to customers. The present invention lets users extend applications across their entire supply chain through the use of replication and workflow.

Multiple layers of security. Many of the Web applications that companies want to develop require multiple layers of security, from basic server access to customized/personalized pages, to page and field-level read/write authority. The present invention's access control security satisfies this requirement and enables companies to establish roles-based access to content.

Cost and development resources are a factor. Whereas initial Web site costs for publishing are typically small regardless of the product used, cost has become an important consideration when developing actual Web applications. The present invention helps minimize cost.

An example will be used for convenient reference.

Company A (a bank) desires to streamline customer service and improve existing business processes with their major commercial customers. They partnered with Company B (a consulting firm) to create an advanced customer support ("ACS") system to address those requirements. The system allows customers to have access to issue submission and tracking information, check imaging applications, customer-support knowledge bases, and other application functionality through a Web client. The system includes built-in workflow capabilities that manage the assignment and notification of key personnel of company A, and automate messaging, faxing, and paging. Customer issue status and service level reporting information is accessed via the Internet.

FIG. **3** illustrates a HTML object **50***a* in accordance with one embodiment of the invention. System **10** permits a representation of non-HTML objects **18***a*–**18***n* to be embedded within HTML objects **50***a*–**50***n*. For example, a system user may retrieve HTML object **50***a*. The system user may request non-HTML object **18***a* to be displayed within HTML object **50***a*.

System **10** retrieves non-HTML object **18***a*. Non-HTML object **18***a* is translated to a HTML representation **50***n* of non-HTML object **18***a*. System **10** uses HTML representation **50***n* to embed HTML representation **50***n* in HTML object **50***a*. FIG. **3** shows HTML object **50***a* with non-HTML objects (and other objects) embedded therein (e.g., pull-down menus **72**, a tool bar **74**, a URL identifier **76**, a form **78**, navigators **80**, links **66**, attachments **82** and fields **62**). After non-HTML object **18***a* is embedded within HTML object **50***a*, HTML object **50***a* may be saved as another object which includes embedded non-HTML object **18***a*.

Preferably, HTML representation **50***n* comprises a table tag and HTML formatting tags. HTML tags are codes used in a HTML object that determine the layout of a HTML object. Views may comprise links to other views. For example, an object may contain a graphical representation of a view. The representation provides a link to the view which is retrieved when a user "clicks" on the representation. When a system user "clicks" on the representation, a URL request for that view is transmitted to HTTP server module **30**. HTTP server module communicates the request to URL interface **46** of interface module **32**. URL interface **46** converts the request into a format supported by non-HTML server module **24**. Non-HTML server module **24** locates and retrieves the view requested and transmits the view to interface module **32**. HTML translator **44** translates the view into HTML and passes the translated view to HTTP server module **30**. HTTP server module **30** communicates the view requested to browser **28** for presenting to the system user. This process may be repeated for each additional view requested by the system user.

Navigators may also be embedded within HTML objects **50***a*–**50***n*. Navigators assist system users in moving through documents. Navigators may be graphical representations or text that identify other portions of a document, other documents, etc. For example, a non-HTML object is requested by a system user. The non-HTML document may comprise a navigator. Module **30** translates the non-HTML object and navigator into HTML object **50***a*.

Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the

specification and practice of the invention disclosed herein. For example, the invention may apply to other client side applications which are based on ULRLs (e.g., news readers). The invention may also translate documents to formats other than HTML. The specification and examples should be considered exemplary only. The scope of the invention is only limited by the claims appended hereto.

What is claimed is:

1. A server system enabling access to one or more non-markup language objects with automatically assigned unique identifiers, using a markup language enabled browser, the unique identifiers alleviating errors relating to broken links, the system comprising:

a web server;

at least one database in communication with the web server that stores one or more non-markup language objects, the one or more non-markup language objects having a name;

a browser interface that enables communication between the web server and a browser, the browser interface enabling access to the one or more non-markup language objects and one or more markup language objects;

an assigning module that assigns the one or more non-markup language objects a unique identifier, the unique identifier being something other than a name of the one or more non-markup language objects; and

wherein the web server;

i) receives a URL-based request from the markup language enabled browser for the one or more non-markup language objects;

ii) determines a location of the one or more non-markup language objects;

iii) retrieves the one or more non-markup language objects based on the unique identifier;

iv) translates the one or more non-markup language objects to at least one second markup language object; and

v) transmits the at least one second markup language object to the browser.

2. The system of claim **1** wherein the object may be renamed, but the unique identifier does not change.

3. The system of claim **1** wherein the at least one database comprises an index of objects within the database, the index being based on the unique identifiers.

4. The system of claim **3** wherein the index is automatically updated when an object is added, created or modified.

5. The system of claim **1** wherein a non-markup language object may be linked to another object by referencing the unique identifier rather than the object name.

6. A server system enabling access to one or more non-markup language objects with automatically assigned unique identifiers using a markup language enabled browser, the unique identifiers alleviating errors relating to broken links, the system comprising:

web server means;

at least one database means associated with the web server means for storing one or more non-markup language objects, the one or more non-markup language objects having a name;

browser interface means for enabling communication between the web server means and browser means, the browser interface means enabling access to the one or more non-markup language objects and one or more markup language objects;

assigning means for assigning the one or more non-markup language objects a unique identifier, the unique identifier being something other than a name of the object; and

wherein the web server means;

i) receives a URL-based request from the markup language enabled browser for the one or more non-markup language objects;

ii) determines a location of the one or more non-markup language objects;

iii) retrieves the one or more non-markup language objects based on the unique identifier;

iv) translates the one or more non-markup language objects to at least one second markup language object; and

v) transmits the at least one second markup language object to the browser.

7. The system of claim **6** wherein the object may be renamed, but the unique identifier does not change.

8. The system of claim **6** wherein the at least one database means comprises an index of objects within the at least one database, the index being based on the unique identifier.

9. The system of claim **8** wherein the index is automatically updated when an object is added, created or modified.

10. The system of claim **1** wherein a non-markup language object may be linked to another object by referencing the unique identifier rather than the object name.

11. A method of enabling access to one or more non-markup language objects with automatically assigned unique identifiers using a markup language enabled browser, the unique identifiers alleviating errors resulting from broken links, the method comprising the steps of:

assigning a unique identifier to one or more non-markup language objects, the unique identifier being something other than a name of the one or more non-markup language objects;

receiving a request for the one or more non-markup language objects from a browser;

determining a location for the one or more non-markup language objects requested;

retrieving the one or more non-markup language objects requested by the unique identifiers;

translating the one or more non-markup language objects to at least one second markup language object; and

transmitting the at least one second markup language object to the browser.

12. An electronic storage medium having processor readable code embodied therein for assigning a unique identifier to one or more non-markup language objects, the electronic storage medium comprising:

processor readable code that causes a processor to assign a unique identifier to one or more non-markup language objects, the unique identifier being something other than a name of the object;

processor readable code that causes a processor to store the one or more non-markup language objects in at least one database;

processor readable code that causes a processor to enable a user to request, using a markup language enabled browser, the one or more non-markup language objects;

processor readable code that causes a processor to determine a location for the one or more non-markup language objects requested;

processor readable code that causes a processor to receive the request, from the browser, for the one or more non-markup language objects requested;

processor readable code that causes a processor to retrieve the one or more non-markup language objects requested based on the unique identifier;

processor readable code that causes a processor to translate the one or more non-markup language objects to at least one markup language object; and

processor readable code that causes a processor to transmit the at least one markup language object to the browser.

13. The medium of claim **12**, wherein the non-markup language objects may be renamed, but the unique identifier does not change.

14. The medium of claim **12**, wherein the at least one database comprises an index of objects within the at least one database, the index being based on the unique identifier.

15. The medium of claim **14** wherein the index is automatically updated when an object is added, created or modified.

16. The medium of claim **12**, wherein a non-markup language object may be linked to another object by referencing the unique identifier.

17. The method of claim **11**, further comprising the step of renaming the one or more non-markup language objects while maintaining the unique identifier unchanged.

18. The method of claim **11**, further comprising the step of automatically updating an index of one or more databases when an object is added, created or modified.

19. The method of claim **11**, further comprising the step of linking one object to another object by referencing the unique identifier.

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