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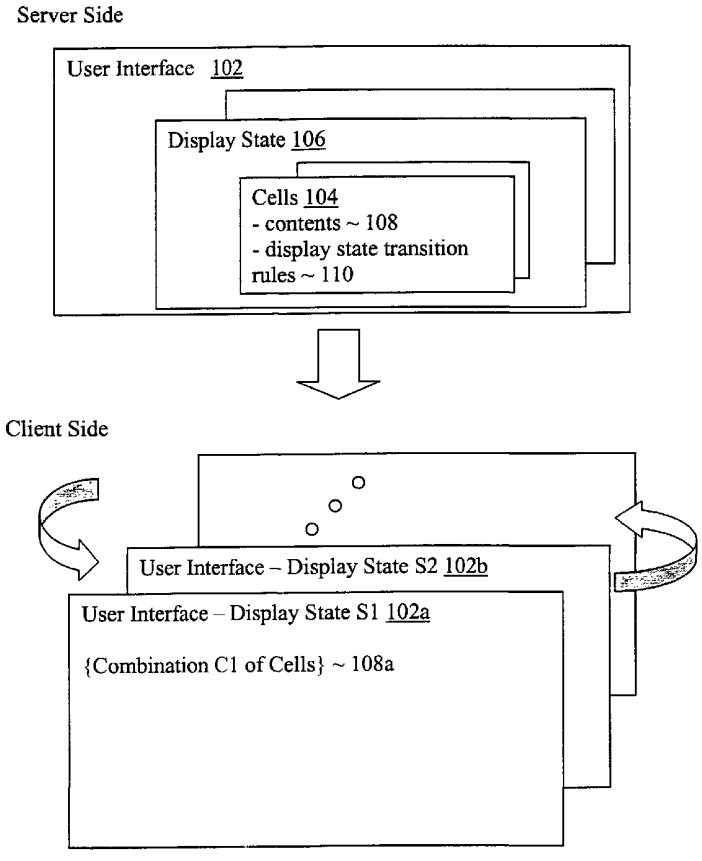
(54) Title: DISPLAY STATE AND/OR CELL BASED USER INTERFACE PROVISION METHOD AND APPARATUS



(57) Abstract: In accordance with a first aspect of the present invention, a user interface is provisioned by a client device determining a next display state of the user interface, and the next instantiation of the user interface is provisioned in accordance with one or more display state definitions corresponding the determined display state, specifying constituting contents of the user interface for the determined display state. In one embodiment, each of the one or more display state definitions includes display state transition rules for various user interactions with the user interface. In accordance with a second aspect of the present invention, a user interface is provisioned by a client device by generating a first portion of a first instantiation of the user interface in accordance with a display cell definition specifying constituting contents of a display cell, and generating a second portion of a second instantiation of the user interface in accordance with the display cell definition, also specifying constituting contents of the second display cell for the second instantiation of the user interface.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Display State and/or Cell Based User Interface Provision Method and Apparatus

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the fields of data processing. More specifically, the present invention relates to the provision of user interfaces.

2. Background Information

With advances in integrated circuit, microprocessor, networking and communication technologies, increasing number of devices, in particular, digital computing devices, are being networked together (wirelessly or via wire lines). As a result of this trend of increased connectivity, increasing number of client/server based and network dependent applications are being deployed. Examples of these client/server based and network dependent applications include but are not limited to, email, net based telephony, world wide web and various types of e-commerce.

Among the client/server based and network dependent applications, thin-client architecture, also known as web-client architecture, perhaps because of its "ease of implementation" on the client side, is especially popular. Typically, the architecture merely involves a "user-agent", such as a Web browser or a WAP (Wireless Access Protocol) Browser, on the client side. There is no need for the client to have any application specific programs installed. Application specific logics are run on the server side, and the client just has to run the "user-agent" to render the user interface (where each instantiation is often referred as a "page" or a "web page"). The "user-agent" retrieves, for each instantiation of a user interface, a set of descriptions for the particular instantiation from the server, and renders the instantiation on a display screen as specified by the retrieved descriptions. The retrievals are made in response to a user's interaction with a current instantiation of the user interface, such as clicking a hyperlink or filling a form. The retrievals to be made are specified (as part of the descriptions) for the "user-agent" for each

potential interaction, without requiring the "user-agent" to make any determination. The descriptions (including subsequent retrieval specifications) are typically authored in a "user-agent" specific language, such as HTML (Hypertext Markup Language) for Web browser, HDML/WML (Handheld Device Markup Language or Wireless Markup Language) for WAP browser.

Although this thin-client architecture allows the application programmers to implement a variety of applications, user experiences are generally poorer than user experiences with other conventional rich client applications (such as Office available from Microsoft of Redmond, WA). One of the reasons is because of the latency involved in the real time retrieval of each next set of definitions across the network. The user often has to wait while the retrieval is being made under the confine of limited networking/communication as well as server bandwidths, which may take upwards of seconds or more. This problem is often referred to as the "user interface latency" problem.

To solve this problem, "scripts" were introduced for HTML and WAP browsers. Script enabled "user-agents" allow authors of thin-client applications to embed some programs (a series of executable instructions) described in scripting-language (such as JavaScript or WMLScript), which give instructions to the "user-agents" on how to handle the user's input, without necessarily having to access the server, and retrieve the next set of user interface descriptions.

Although "scripting" was a sufficient solution for a certain set of user interactions (such as verifying that the user filled a certain field before submitting that data to the server), it significantly added the complexity to the development of thin client applications. Scripting is also not suitable when complex computations are required (such as determining the response to a user's move in a chess game), because of the limited resources on the client devices as well as the limitation of the script language itself.

HDML (and its successor, WML) introduced the concept of "cards and decks", which allows the "user-agent" to retrieve multiple sets of user interface descriptions in a single round-trip. Each card describes a single unit of interaction including information to be presented to the user, and instructions for user inputs. A user essentially interacts or navigates through a series of

cards. Multiple cards may be organized into a deck, which is equivalent to an HTML page. Although it reduces the number of round-trips in a certain set of scenarios, because it requires one card for each possible set of user interactions, it is not possible to apply this technology when the possible number of units of interactions is large or near infinite, as the number of user interface descriptions and their corresponding contents retrieved are large or near infinite. For example, if a user interface has 100 possible sets of user interactions, the descriptions of 100 cards must be retrieved in one round-trip or these descriptions must be separated into multiple decks and retrieved separately. Thus, the user still experience delays either due to the large amount of data to be transmitted in a single round trip or having to make multiple round trips.

Thus, what is needed is a new approach to provisioning user interface, that is more powerful in addressing large possible responses by the user, and allowing the solution to be client based (thereby eliminating the latency), but without the limitations and disadvantages of the prior art.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention, a user interface is provisioned by a client device locally determining a next display state of the user interface, and the next instantiation of the user interface is provisioned by the client device in accordance with one or more display state definitions corresponding to the determined display state, specifying constituting contents of the user interface for the determined display state. In one embodiment, each of the one or more display state definitions includes display state transition rules for various user interactions with the user interface.

In accordance with a second aspect of the present invention, a user interface is provisioned by a client device generating a first portion of a first instantiation of the user interface in accordance with a display cell definition specifying constituting contents of a display cell, and generating a second portion of a second instantiation of the user interface in accordance with the

display cell definition, which also specifies the constituting contents of the display cell for the second portion of the second instantiation. That is, a display cell definition may specify a display cell for multiple display states. In one embodiment, the display states are multi-dimensional.

Further, in one embodiment, the display state transition rules are specified at the display cell level. In one embodiment, a display cell may also inherit constituting contents from another display cell. A display cell may even be a pseudo display cell.

In one embodiment, an application server is provided with a user interface provision function incorporated with the state and/or cell based approach to user interface provisioning. The application server, in response to a remote client device's request for a user interface, transmits to the remote client device the state and/or cell based definitions and the constituting contents for the different instantiations of the user interface. In one embodiment, a server is provided to host the application server having the user interface provision function of the present invention.

In one embodiment, a user agent is provided with a user interface provision function incorporated with the state and/or cell based approach to user interface provisioning. In one embodiment, a client device selected from a device group consisting at least a wireless telephone, a palm sized computing device, and a notebook sized computing device, is provided to host the user agent having the user interface provision function of the present invention.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

Figure 1 illustrates an overview of the present invention, in accordance with one embodiment;

Figures 2a-2d illustrate different instantiations of a user interface of an example application;

Figure 3 illustrates an example network of clients and server devices suitable for practicing the present invention, in accordance with one embodiment;

Figure 4 illustrates a method view of practicing the present invention in the example network environment of **Fig. 3**;

Figures 5a-5b illustrate the operational flow of the relevant aspects of the user-agent of **Fig. 3**, in accordance with one embodiment; and

Figure 6 illustrates an architectural view of an example computing device, suitable for use as either a client or a server device to practice the present invention, in accordance with one embodiment.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, various aspects of the present invention will be described. However, it will be apparent to those skilled in the art that the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, it will also be apparent to one skilled in the art that the present invention may be practiced without the specific details. In other instances, well known features are omitted or simplified in order not to obscure the present invention.

Parts of the description will be presented using terms such as user interfaces, buttons, and so forth, commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. Parts of the description will be presented in terms of operations performed by a computing device, using terms such as clicking, determining, rendering, and so forth. As well understood by those skilled in the art, these quantities and operations take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and otherwise manipulated through mechanical and electrical components of a digital system. The term digital system includes

general purpose as well as special purpose computing machines, systems, and the like, that are standalone, adjunct or embedded.

Various operations will be described in turn in a manner that is most helpful in understanding the present invention, however, the order of description should not be construed as to imply that these operations are necessarily order dependent. Furthermore, the phrase "in one embodiment" will be used repeatedly, however the phrase does not necessarily refer to the same embodiment, although it may.

Referring now to **Figure 1**, wherein a block diagram illustrating an overview of the present invention, in accordance with one embodiment is shown. As illustrated, in accordance with one aspect of the present invention, a user interface **102** is provisioned through the employment of display states defined by display state definitions **106**. Each display state definition **106** includes specification **108** for the constituting contents (not shown) for an instantiation (or portion thereof) of user interface **102**, e.g. **102a**, **102b**, and so forth, and display state transition rules **110**, specifying the next display state (or instantiation) of user interface **102** in the event of user interactions with the displayed content.

In accordance with another aspect of the present invention, a user interface **102** is provisioned through the employment of display cells correspondingly defined by display cell definitions **104**. Each display cell definition **104** includes specification **108** for the constituting contents (not shown) of the display cell. The display cell may be displayed in different instantiations (or display states) of the user interface. That is, a display cell definition may specify a display cell for one or more display states.

For the illustrated embodiment, both aspects of the present invention are practiced. More specifically, each display state definition **108** includes applicable ones of the display cell definitions **104**, and each display cell definition **104** includes specifcation **110** for a display state transitional rule, specifying the next display state (or instantiation) of user interface **102** in the event a user interacts with the rendered display cell **104** being defined. As will

be described in more detail below, the present invention advantageously allows the display states to be of one or more dimensions. Further, a display cell may inherit its consituting contents from another display cell, which may be a pseudo display cell. Together, these characteristics advantageously provide for a much more compact approach in defining the different instantiations of a user interface.

While **Fig. 1** illustrated a "nested" embodiment, with each display state definition **106** including one or more display cell definitions **104**, and each of a number of selected ones of the display cell definitions **104** including display state transition rules **110**, the present invention contemplates that in alternate embodiments, display states, display state transitional rules, and display cells may all be independently defined, and cross referenced to each other (or some combinations thereof), as opposed to the "nested" approach of **Fig. 1**.

Thus, under the present invention, each instantiation of the user interface, **102a**, **102b**, etc. may be provisioned by a client device generating the different portions of the instantiation in accordance with the corresponding display cell definitions specifying constituting contents of the corresponding display cells of the instantiation. In one embodiment, display state definitions **106** (inclusive with display cells specifications **106** having display state transition rules **110**), and consituting contents of the display cells, are "pre-provided" from the server side to the client side. The client side locally determines a next display state of user interface **102**, and the next instantiation, e.g. **102a** or **102b**, is provisioned by the client device in accordance with the "display state definition/definitions" of the determined display state.

[Note that "pre-provision" may be made in stages, e.g. with the initial definitions and contents being provided first, and subsequent definitions and contents being provided in parallel while the initial instantiation is being rendered and during the "think time" of the initial instantiation. Other variations of staged "pre-provision" may also be practiced.]

Thus, the present invention advantageously allows the client device to locally determine and renders different instantiations of a user interface, without having to make the often time consuming real-time retrievals from an

application server, in between instantiations of an user interface. Moreover, as alluded to earlier, the advantages are made possible in a very compacted approach. As will be even more readily apparent from the descriptions to follow, the state and/or cell based approach of the present invention to specifying the different instantiations of an user interface is highly scalable and because of its compactness, much more flexible in addressing situations where a relatively large number of user interactions are possible.

Referring now to **Figures 2a-2d**, wherein an example application of the present invention is illustrated. Illustrated therein are four instantiations of an user interface of a card game, where a user is to select one of three displayed cards. Depending on the selection, a user will either win, lose or draw. The example application is purposely kept simply for ease of understanding. Nevertheless, for one ordinarily skilled in ther art, the key principles of the present invention are fully illustrated.

Figure 2a illustrates an initial instantiation of the user interface **102aa** of the card game, where the back side of three cards **206**, along with the title of the game **202**, and an instruction **204a** for the player are rendered. **Figure 2b** illustrates a second instantiation of the user interface **102ab** of the card game, where the face of the first card **208a** (selected by the user), the back side of the remaining two cards **206**, along with the title of the game **202**, and a "winning" message **204b** for the player are rendered.

Figure 2c illustrates a third instantiation of the user interface **102ac** of the card game, where the face of the second card **208b** (selected by the user), the back side of the remaining two cards **206**, along with the title of the game **202**, and a "losing" message **204c** for the player are rendered. Finally, **Figure 2d** illustrates a fourth instantiation of the user interface **102ad** of the card game, where the face of the third card **208c** (selected by the user), the back side of the remaining two cards **206**, along with the title of the game **202**, and a "draw" message **204c** for the player are rendered.

Thus, in accordance with the present invention, the various instantiations of the user interface **102aa-102ad**, the conditions under which

they are rendered, and the transitions between the instantiations may be advantegouesly specified using

(1) four display states, s1 through s4, where s1 is the initial "make a selection" state, s2 is the display state upon selection of the first card (i.e. the "win" state), s3 is the display state upon selection of the second card (i.e. the "lose" state), and s4 is the display state upon selection of the third card (i.e. the "draw" state);

(2) three transition rules, rule 1 - transitioning from state s1 to state s2 on selection of the first card, rule 2 - transitioning from state s1 to state s3 on selection of the second card, and rule 3 – transitioning from state s1 to state s3 on selection of the third card; and

(3) eleven display cells,

a. cell 1 for the title of the game (which is visible in all states),
b. cell 2 for the instruction of the game (which is visible in state 1),
c. cell 3 for the back of the first card (which is visible in states 1, 3 and 4),
d. cell 4 for the back of the second card (which is visible in states 1, 2 and 4),
e. cell 5 for the back of the third card (which is visible in states 1, 2 and 3),
f. cell 6 for the face of the first card (which is visible in state 2),
g. cell 7 for the face of the second card (which is visible in state 3),
h. cell 8 for the face of the third card (which is visible in state 4),
i. cell 9 for the "winning" message (which is visible in state 2),
j. cell 10 for the "losing" message (which is visible in state 3), and
k. cell 11 for the "draw" message (which is visible in state 4).

Further, in accordance with the illustrated embodiment, these specifications may be made using a number of cell definitions (with the display states and display state transition rules distributively defined therein).

Enumerated below (with some details, e.g. positional specifications, omitted) is an example of such specifications in XML:

```
<States default="S=1">
    <State id="Title">
        <Cell type="text">Card game</Cell>
    </State>
    <State id="S=1" inherit "Title">
        <Cell type="text">Select a Card</Cell>
        <Cell type="img" src="back.jpg" onSelect="S=2"/>
        <Cell type="img" src="back.jpg" onSelect="S=3"/>
        <Cell type="img" src="back.jpg" onSelect="S=4"/>
    </State>
    <State id="S=2" inherit "Title">
        <Cell type="text">You win</Cell>
        <Cell type="img" src="eight.jpg"/>
        <Cell type="img" src="back.jpg"/>
        <Cell type="img" src="back.jpg"/>
    </State>
    <State id="S=3" inherit "Title">
        <Cell type="text">You lose</Cell>
        <Cell type="img" src="back.jpg"/>
        <Cell type="img" src="six.jpg"/>
        <Cell type="img" src="back.jpg"/>
    </State>
    <State id="S=4" inherit "Title">
        <Cell type="text">Draw</Cell>
        <Cell type="img" src="back.jpg"/>
        <Cell type="img" src="back.jpg"/>
        <Cell type="img" src="nine.jpg"/>
    </State>
</States>
```

Note that in the above enumerated example, the notions of a pseudo display state and inheritance were also introduced to facilitate specification of

the display of the title "Card Game" in each instantiation of the user interface. A pseudo display state "Title" is specified, and its constituting content ("Card Game") is inherited by each of the other display states. A pseudo display state is a display state that in and of itself does not get rendered to form an instantiation of the user interface. As a result, the user interface may be specified in a much more compact manner, reducing the transmission time and bandwidth required to retrieve the user interface

For ease of understanding, the above example illustrated four display states, within a single dimension, the dimension of the win, lose or draw. However, the present invention specifically contemplates the display states may be multi-dimensional.

Consider for example, a new "betting" dimension, where $1, $5 or $10 bet may be placed, is added to the above described example Card Game. Along this "betting" dimension, the Card Game may be said to be in a state T0, where no bet has been placed, a state T1, where a $1 bet has been placed, in a state T2, where a $5 bet has been placed, and in a state T3, where a $10 bet has been placed. Accordingly, the various instantiations of the user interface can be said to correspond to the eleven "two dimensional" display states of (T0, x), (T1, S1), (T2, S1), (T3, S1), (T1, S2), (T2, S2), (T3, S2), (T1, S3), (T2, S3), (T3, S3), (z, S4). [It is assumed that the Game would not permit a win, lose or draw state, nor the choosing of a card, without a bet being placed. Thus, (T0, S1), (T0, S2), (T0, S3), and (T0, S4) are "illegal" or "impossible" states. Further, as long as the display state is in the draw state in the win, lose or draw dimension, it is immaterial as far as the amount of bet placed.]

Assume further that the user (player) is given a $100 at the beginning of the game, the various instantiations of the user interface may be specified by the following expanded XML specification:

```
<States default="T=0">
    <State id="Title">
        <Cell type="text">Card game</Cell>
    </State>
    <State id="T=0" inherit "Title">
        <Cell type="text">You have a $100</Cell>
```

```
        <Cell type="text">Choose your bet</Cell>
        <Cell type="text" on Select="S=1 T=1">$1</Cell>
        <Cell type="text" on Select="S=1 T=2">$5</Cell>
        <Cell type="text" on Select="S=1 T=3">$10</Cell>
</State>
<State id="T1">
        <Cell type="text">Your bet: $1</Cell>
</State>
<State id="T2">
        <Cell type="text">Your bet: $5</Cell>
</State>
<State id="T3">
        <Cell type="text">Your bet: $10</Cell>
</State>
<State id="S=1" inherit "Title">
        <Cell type="text">Select a Card</Cell>
        <Cell type="img" src="back.jpg" onSelect="S=2"/>
        <Cell type="img" src="back.jpg" onSelect="S=3"/>
        <Cell type="img" src="back.jpg" onSelect="S=4"/>
</State>
<State id="S=2" inherit "Title">
        <Cell type="text">You win</Cell>
        <Cell type="img" src="eight.jpg"/>
        <Cell type="img" src="back.jpg"/>
        <Cell type="img" src="back.jpg"/>
</State>
<State id="S=3" inherit "Title">
        <Cell type="text">You lose</Cell>
        <Cell type="img" src="back.jpg"/>
        <Cell type="img" src="six.jpg"/>
        <Cell type="img" src="back.jpg"/>
</State>
<State id="S=4" inherit "Title">
```

```
            <Cell type="text">Draw</Cell>
            <Cell type="img" src="back.jpg"/>
            <Cell type="img" src="back.jpg"/>
            <Cell type="img" src="nine.jpg"/>
            <Cell type="text">You have: $100</Cell>
        </State>
        <State id="T=1 && S=2">
            <Cell type="text">You have: $101</Cell>
        </State>
        <State id="T=2 && S=2">
            <Cell type="text">You have: $105</Cell>
        </State>
        <State id="T=3 && S=2">
            <Cell type="text">You have: $110</Cell>
        </State>
        <State id="T=1 && S=3">
            <Cell type="text">You have: $99</Cell>
        </State>
        <State id="T=2 && S=3">
            <Cell type="text">You have: $95</Cell>
        </State>
        <State id="T=3 && S=3">
            <Cell type="text">You have: $90</Cell>
        </State>
    </States>
```

In the immediate above example, it is assumed that if the display state value is specified for only one dimension, the display state value for the other dimension is "don't care". Thus, the specified display cells will get rendered as long as the display state value corresponds in the specified dimension. For example, for the display cells specified for display state "S=2", the display cells get rendered for display states (T1, S2), (T2, S2) as well as (T3, S2). In other words, the present invention also contemplates that a display cell definition may be specified for a display cell for one or more single or multi-dimension

display states, thereby further increasing the compactness of the user interface definition or provisioning of the present invention, and the latency reduction benefits that results.

Referring now to **Figure 3**, where in an example network of client and server devices, suitable for use to practice the present invention is shown. As illustrated, client devices **312** are coupled to web site **302** via internetworking fabric **330**. Web site **302** includes web application **304** constructed in accordance with the teachings of the present invention. That is, the user interface of web application **304** is compactly constructed in accordance with the state and/or cell based approach of the present invention. Web application **304** is intended to represent a broad range of applications known in the art. Web site **302** further includes web server **308**, which is also intended to represent a broad range of such servers known in art, for sending "pages" or "web pages" to coupled client devices **312**, except in the present case, web server **308** includes a user interface provisioning function (not shown), equipped to "pre-provide" the instantiations of the user interface compactly defined in the state and/or cell based form, as described earlier.

Each of client devices **312** includes user agent **314**, incorporated with the state and cell based user interface rendering engine **320** of the present invention. User agent **314**, state and cell based user interface rendering engine **320** in particular, renders the state and/or cell based instantiations of user interface **304'** as described earlier. User agent **314** may be a browser, an operating system, and the like. Client devices **312** are intended to represent a broad range of such devices known in the art, including but are not limited to wireless telephones, palm sized personal digital assistants (PDA), notebook sized computers, desktop computers, set top boxes and the like.

While for ease of understanding, only one web site **302** and two client devices **312** are illustrated, those skilled in the art will appreciate that the present invention may be practiced with one or more web sites **302** having selected combinations of any number of client devices **312** accessing

applications with user interfaces constructed and rendered in accordance with the present invention.

Referring now to **Figure 4**, wherein a method view of the present invention, in accordance with one embodiment, is shown. As illustrated, at block **402**, a client device requests for an application from a remote application server. The user interface of the application is advantageously constructed in accordance with the state and/or cell based approach of the present invention. In response, at block **404**, the application server provides the client device with the compactly defined display cell definitions for the various (single or multi-dimensional) display states of the user interface, along with the constituting contents of the display cells.

At block **406**, the user interface rendering engine (of the "user agent") of the client device determines the "next" display state, and renders the "next" instantiation of the user interface, in accordance with the "next" display state's definition, and using the constituting contents provided. [Note that the user interface rendering engine (of the "user agent") of the client device may render the "initial" instantiation of the user interface, as soon as the "initial" definitions and corresponding contents are provided. Thus, the present invention may be further advantageously practiced with the server providing the "initial" definitions and contents first.] At block **408**, a user interacts with the current instantiation of the user interface. In response, the process continues back at block **406** again, that is the user interface rendering engine (of the "user agent") of the client device determines the "next" display state, and renders the "next" instantiation of the user interface, in accordance with the "next" display state's definition, and using the constituting contents provided.

Blocks **406** and **408** are repeatedly performed until eventually the user takes certain action which results in the dispensing of the user interface.

As those skilled in the art would appreciate, by virtue of the fact that the user interface may be compactly provided to the remote client device, the user interface may be provided initially with reduced latency. Further, thereafter, because the subsequent instantiations may be provided without having to access the remote server, each of these instantiations may be provided with

significant reduction in latency, thereby significantly improving a user's experience.

Figures 5a-5b illustrate the operational flow of the relevant aspects of the user interface rendering function of user agent **314** of **Fig. 3**. **Figure 5a**, illustrates the overall process for rendering the various instantiations, whereas **Figure 5b** illustrates the process for rendering a specific instantiation.

As illustrated in **Fig. 5a**, upon invocation, at block **502**, the user interface rendering function renders the current instantiation of the user interface, in accordance with the display state definition/definitions for the determined current display state. Thereafter, at block **504**, the user interface rendering function awaits for user inputs, i.e. user interaction with one of the rendered display cells. Upon detection of the user interaction, at block **506**, the user interface rendering function sets the display state in accordance with the display state transitional rule specified for the rendered display cell, with which the user interacted. The process then continues back at block **502**.

As illustrated in **Fig. 5b**, the user interface rendering function renders a current instantiation of the user interface, one display cell at a time, block **512**. The process continues until all display cells specified for a display state have been rendered, block **514**.

Figure 6 illustrates an example computing device suitable for use to practice the present invention as a client or server device, in accordance with one embodiment. As shown, client/server **600** includes one or more processors **602** and system memory **606**. The number of processors and the size of memory employed are typically dependent on whether the example computing device **600** is used as a client or server device. For example, if used as a server device, probably multiple high performance processors are employed. On the other hand, if used as a wireless telephone, probably a lower performance micro-controller is used instead.

Additionally, device or system **600** includes mass storage devices **607** (such as diskette, hard drive, CDROM and so forth, again depending on whether it is used as client or a server device), GPIO **608** (for interfacing with I/O devices such as keyboard, cursor control and so forth) and communication interfaces **612** (such as network interface cards, modems and so forth). The elements are coupled to each other via system bus **614**, which represents one or more buses. In the case of multiple buses, they are bridged by one or more bus bridges (not shown).

Each of these elements performs its conventional functions known in the art. In particular, system memory **604** and mass storage **606** are employed to store a working copy and a permanent copy of the programming instructions implementing the web server (in the case of a server device) or the user agent (in the case of the client device).

Except for its use to host the novel web server or user agent incorporated with the teachings of the present invention, the constitution of these elements **602-614** are known, and accordingly will not be further described.

Accordingly, a state and/or cell based method and apparatus for provisioning user interface has been described. While the present invention has been described in terms of the above illustrated embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments described. The present invention can be practiced with modification and alteration within the spirit and scope of the appended claims. Thus, the description is to be regarded as illustrative instead of restrictive on the present invention.

CLAIMS

What is claimed is:

1. A method for provisioning user interface comprising:

determining locally by a client device, a current display state for a user interface; and

provisioning by the client device, a current instantiation of said user interface in accordance with one or more display state definitions corresponding to the determined current display state, each of said one or more display state definitions including one or more display cell definitions for one or more display cells of said user interface.

2. The method of claim 1, wherein said determining is locally made by said client device in accordance with a display cell definition for a rendered display cell of an immediately preceding instantiation of the user interface with which a user interacted, said display cell definition including a state transition rule specifying the display state for the user interface in the event a user interacts with the rendered display cell.

3. The method of claim 1, wherein said provisioning comprises generating by said client device at least a first portion of the current instantiation of the user interface in accordance with a first display cell definition for a first display cell of the user interface, the first display cell definition specifying constituting contents of said first display cell of the user interface.

4. The method of claim 3, wherein said provisioning further comprises generating by said client device a second portion of the current instantiation of the user interface in accordance with a second display cell definition for a second display cell of the user interface, the second display cell definition specifying constituting contents of said second display cell of the user interface.

5. The method of claim 1, wherein said provisioning comprises generating by said client device a portion of the current instantiation of the user interface with constituting contents inherited from a pseudo instantiation of the user interface based on a pseudo display state.

6. The method of claim 1, wherein said display state is multi-dimensional.

7. A method for provisioning user interface comprising:

generating by a client device a first portion of a first instantiation of an user interface in accordance with a display cell definition for a display cell, the display cell definition specifying constituting contents for said display cell for said first portion of said first instantiation of said user interface; and

generating by the client device a second portion of a second instantiation of said user interface in accordance withsaid display cell definition forsaid display cell, said display cell definition also specifying constituting contents for said display cell for said second portion of said second instantiation of said user interface.

8. The method of claim 7, wherein said method further comprises generating by said client device a third portion of said first/second instantiation of said user interface with constituting contents inherited from a pseudo instantiation of the user interface.

9. A method for provisioning user interface comprising:

generating by a client device a first portion of an instantiation of a user interface with constituting contents inherited from a pseudo instantiation of the user interface; and

generating by the client device a second portion of said instantiation of said user interface in accordance with a display cell definition for a display cell, the display cell definition specifying constituting contents for said display cell for said instantiation of said user interface.

10. A method for provisioning user interface comprising:

provisioning by a client device a first instantiation of a user interface in accordance with a first one or more display state definitions;

determining locally by said client device a next display state for the user interface based on a user's interaction with a portion of the first instantiation of the user interface and in accordance with said first one or more display state definitions, which include specifications for state transition rules in the event of user interactions; and

provisioning by the client device a next instantiation of the user interface in accordance with a second one or more display state definitions for the determined next display state.

11. A method for provisioning user interface comprising:

transmitting by a server to a remote client device, a first one or more display state definitions specifying constituting contents for a first plurality of display cells of a first instantiation of an user interface;

transmitting by the server to said remote client device, said constituting contents for said first plurality of display cells for rendering on said remote client device in accordance with said first display state definition;

transmitting further in advance by the server to said remote client device, a second one or more display state definitions specifying constituting contents for a second plurality of display cells of a second instantiation of an user interface to be rendered in response to a first user interaction with said first instantiation of the user interface; and

transmitting further in advance by the server to said remote client device, said constituting contents for said second plurality of display cells for rendering on said remote client device in accordance with said second display state definition in the event said first user interaction occurs.

12. The method of claim 11, wherein the method further comprising:

transmitting by the server to said remote client device, constituting content of a pseudo instantiation of said user interface to be inherited in at least a selected one of said rendering of said first and said second instantiation of said user interface.

13. The method of claim 11, wherein each of said first and second one or more display state definitions comprises first/second plurality of display cell definitions correspondingly specifying constituting contents for said first/second plurality of display cells.

14. The method of claim 13, wherein each of said first and second display cell definitions further comprises first/second plurality of display state transition rules correspondingly specifying display states to be transitioned to in the event of user interactions with the first/second display cells.

15. A product comprising:

a first plurality of programming instructions to implement a user interface provision function equipped to determine a current display state for a user interface, and to provision a current instantiation of said user interface in accordance with one or more display state definitions for the determined current display state, each of one or more said display state definitions including one or more display cell definitions for one or more display cells of said user interface; and

a second plurality of programming instructions implementing at least one other product function.

16. The product of claim 15, wherein said first programming instructions further equip said user interface provision function to make said determination in accordance with a display cell definition for a rendered display cell of an immediately preceding instantiation of the user interface with which a user interacted, said display cell definition including a state transition rule specifying the display state for the user interface in the event a user interacts with the rendered display cell.

17. The product of claim 15, wherein said first programming instructions further equip said user interface provision function to perform said provisioning by generating at least a first portion of the current instantiation of the user

interface in accordance with a first display cell definition for a first display cell of the user interface, the first display cell definition including constituting contents of said first display cell of the user interface.

18. The product of claim 17, wherein said first programming instructions further equip said user interface provision function to perform said provisioning by generating a second portion of the current instantiation of the user interface in accordance with a second display cell definition for a second display cell of the user interface, the second display cell definition including constituting contents of said second display cell of the user interface.

19. The product of claim 15, wherein said first programming instructions equip said user interface provision function to perform said provisioning by generating a portion of the current instantiation of the user interface with constituting contents inherited from a pseudo instantiation of the user interface based on a pseudo display state.

20. The product of claim 15, wherein said display state is multi-dimensional.

21. The product of claim 15, wherein the product is a selected one of a browser and an operating system.

22. A product comprising:

a first plurality of programming instructions to implement a user interface provision function equipped to generate a first portion of a first instantiation of an user interface in accordance with a display cell definition for a display cell, the display cell definition specifying constituting contents for said first display cell for said first portion of said first instantiation of said user interface, and to generate a second portion of a second instantiation of said user interface in accordance with said display cell definition for said display cell, the display cell definition also specifying constituting contents for said display cell for said second portion of said second instantiation of said user interface; and

a second plurality of programming instructions to implement at least one other product function.

23. The product of claim 22, wherein said first programming instructions further equip said user interface provision function to generate a third portion of said first/second instantiation of said user interface with constituting contents inherited from a pseudo instantiation of the user interface.

24. A product comprising:

a first plurality of programming instructions to implement a user interface provision function equipped to generate a first portion of an instantiation of a user interface with constituting contents inherited from a pseudo instantiation of the user interface, and to generate a second portion of said instantiation of said user interface in accordance with a display cell definition for a display cell, the display cell definition specifying constituting contents for said display cell for said instantiation of said user interface; and

a second plurality of programming instructions to implement at least one other product function.

25. A product comprising:

a first plurality of programming instructions to implement a user interface provision function equipped to provision a first instantiation of a user interface in accordance with a first one or more display state definitions, to determine a next display state for the user interface based on a user's interface with a portion of the first instantiation of the user interface and in accordance with said first one or more display state definitions, which include specifications for state transition rules in the event of user interactions, and to provision a next instantiation of the user interface in accordance with a second one or more display state definitions for the determined next display state; and

a second plurality of programming instructions to implement at least one other product function.

26. An application server comprising:

a first plurality of programming instructions to implement a communication function; and

a second plurality of programming instructions to implement a user interface provision function equipped to transmit to a remote client device, a first one or more display state definitions specifying constituting contents for a first plurality of display cells of a first instantiation of an user interface, and constituting contents for said first plurality of display cells for rendering on said remote client device in accordance with said first one or more display state definitions, and to transmit further in advance to said remote client device, a second one or more display state definitions specifying constituting contents for a second plurality of display cells of a second instantiation of an user interface to be rendered in response to a first user interaction with said first instantiation of the user interface, and said constituting contents for said second plurality of display cells for rendering on said remote client device in accordance with said second one or more display state definitions in the event said first user interaction occurs.

27. The application server of claim 26, wherein the second plurality of programming instructions further equip the user interface provision function to transmitting to said remote client device, constituting content of a pseudo instantiation of said user interface to be inherited in at least a selected one of said rendering of said first and said second instantiation of said user interface.

28. The application server of claim 26, wherein each of said first and second one or more display state definitions comprises first/second plurality of display cell definitions correspondingly specifying constituting contents for said first/second plurality of display cells.

29. The application server of claim 28, wherein each of said first and second display cell definitions further comprises first/second plurality of display state transition rules correspondingly specifying display states to be transitioned to in the event of user interactions with the first/second display cells.

30. A client device comprising:

a storage medium having stored therein a plurality of programming instructions to implement a user interface provision function equipped to determine a current display state for a user interface, and to provision a current instantiation of said user interface in accordance with one or more display state definitions for the determined current display state, each of said one or more display state definitions including one or more display cell definitions for one or more display cells of said user interface; and

a processor coupled to the storage medium to execute the programming instructions.

31. The client device of claim 30, wherein said programming instructions further equip said user interface provision function to make said determination in accordance with a display cell definition for a rendered display cell of an immediately preceding instantiation of the user interface with which a user interacted, said display cell definition including a state transition rule specifying the display state for the user interface in the event a user interacts with the rendered display cell.

32. The client device of claim 30, wherein said programming instructions further equip said user interface provision function to perform said provisioning by generating at least a first portion of the current instantiation of the user interface in accordance with a first display cell definition for a first display cell of the user interface, the first display cell definition including constituting contents of said first display cell of the user interface.

33. The client device of claim 32, wherein said programming instructions further equip said user interface provision function to perform said provisioning by generating a second portion of the current instantiation of the user interface in accordance with a second display cell definition for a second display cell of the user interface, the second display cell definition including constituting contents of said second display cell of the user interface.

34. The client device of claim 30, wherein said programming instructions equip said user interface provision function to perform said provisioning by generating a portion of the current instantiation of the user interface with constituting contents inherited from a pseudo instantiation of the user interface based on a pseudo display state.

35. The client device of claim 30, wherein said display state is multi-dimensional.

36. The client device of claim 30, wherein the client device is a selected one of a wireless telephone, a palm sized computing device, and a notebook sized computing device.

37. A client device comprising:

a storage medium having stored therein a plurality of programming instructions to implement a user interface provision function equipped to generate a first portion of a first instantiation of an user interface in accordance with a display cell definition for a display cell, the display cell definition specifying constituting contents for said display cell for said first portion of said first instantiation of said user interface, and to generate a second portion of a second instantiation of said user interface in accordance with said display cell definition for said display cell, said display cell definition also specifying constituting contents for said display cell for said second portion of said second instantiation of said user interface; and

a processor coupled to the storage medium to execute the programming instructions.

38. The client device of claim 37, wherein said programming instructions further equip said user interface provision function to generate a third portion of said first/second instantiation of said user interface with constituting contents inherited from a pseudo instantiation of the user interface.

39. A client device comprising:

a storage medium having stored therein a plurality of programming instructions to implement a user interface provision function equipped to generate a first portion of an instantiation of a user interface with constituting contents inherited from a pseudo instantiation of the user interface, and to generate a second portion of said instantiation of said user interface in accordance with a display cell definition for a display cell, the display cell definition specifying constituting contents for said display cell for said instantiation of said user interface; and

a processor coupled to the storage medium to execute the programming instructions.

40. A client device comprising:

a storage medium having stored therein a plurality of programming instructions to implement a user interface provision function equipped to provision a first instantiation of a user interface in accordance with a first one or more display state definitions, to determine a next display state for the user interface based on a user's interface with a portion of the first instantiation of the user interface and in accordance with said first one or more display state definitions, which include specifications for state transition rules in the event of user interactions, and to provision a next instantiation of the user interface in accordance with a second one or more display state definitions for the determined next display state; and

a processor coupled to the storage medium to execute the programming instructions.

41. A server comprising:

a storage medium having stored therein a plurality of programming instructions to implement a user interface provision function equipped to transmit to a remote client device, a first one or more display state definitions specifying constituting contents for a first plurality of display cells of a first instantiation of an user interface, and constituting contents for said first plurality of display cells for rendering on said remote client device in accordance with said first one or more display state definitions, and to transmit further in

advance to said remote client device, a second one or more display state definitions specifying constituting contents for a second plurality of display cells of a second instantiation of an user interface to be rendered in response to a first user interaction with said first instantiation of the user interface, and said constituting contents for said second plurality of display cells for rendering on said remote client device in accordance with said second one or more display state definitions in the event said first user interaction occurs; and

at least one processor coupled to the storage medium to execute the programming instructions.

42. The server of claim 41, wherein the plurality of programming instructions further equip the user interface provision function to transmitting to said remote client device, constituting content of a pseudo instantiation of said user interface to be inherited in at least a selected one of said rendering of said first and said second instantiation of said user interface.

43. The server of claim 41, wherein each of said first and second one or more display state definitions comprises first/second plurality of display cell definitions correspondingly specifying constituting contents for said first/second plurality of display cells.

44. The server of claim 43, wherein each of said first and second display cell definitions further comprises first/second plurality of display state transition rules correspondingly specifying display states to be transitioned to in the event of user interactions with the first/second display cells.

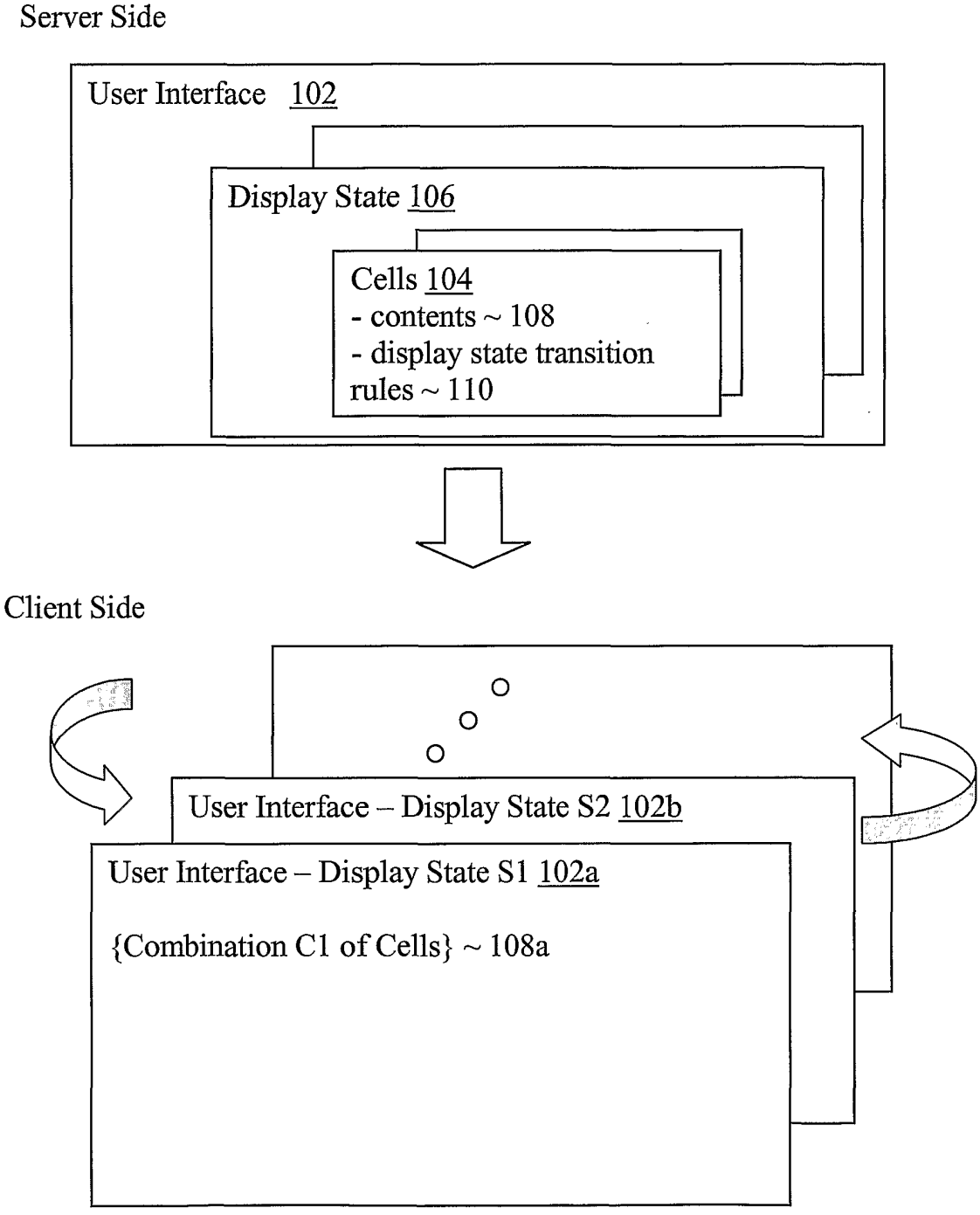
Server Side
User Interface 102
Display State 106
Cells 104
- contents ~ 108
- display state transition rules ~ 110
Client Side
User Interface – Display State S2 102b
User Interface – Display State S1 102a
{Combination C1 of Cells} ~ 108a

Figure 1

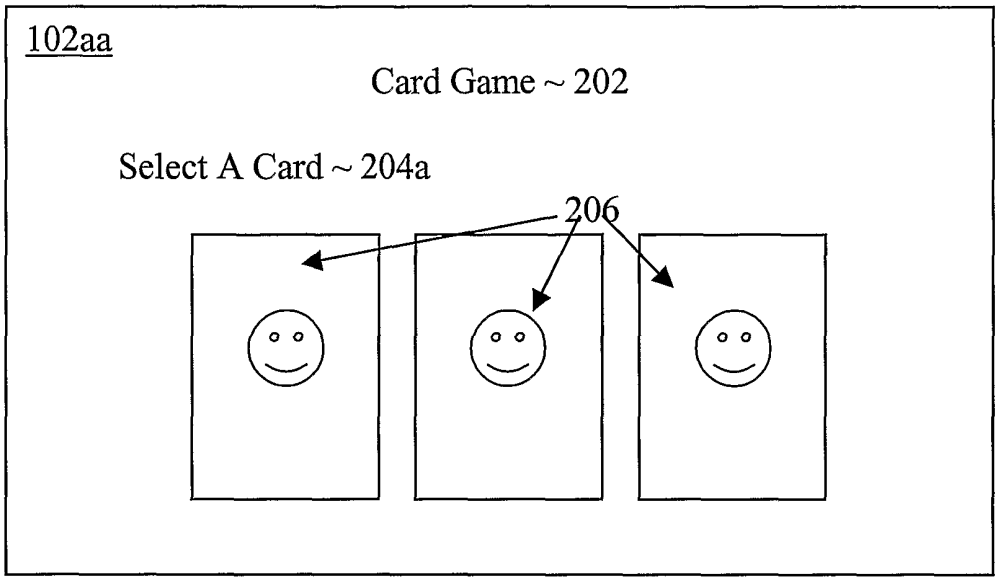

Figure 2a

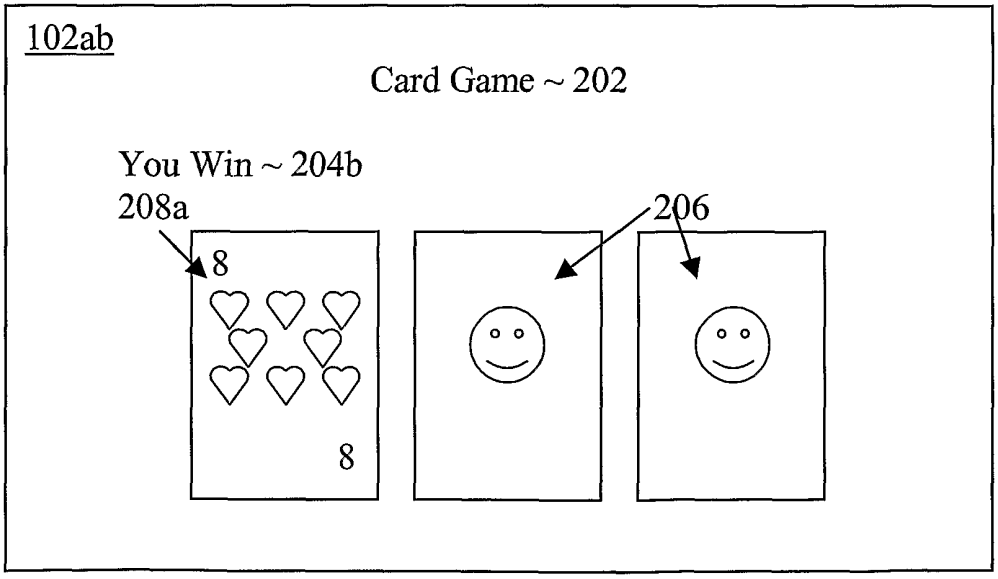

Figure 2b

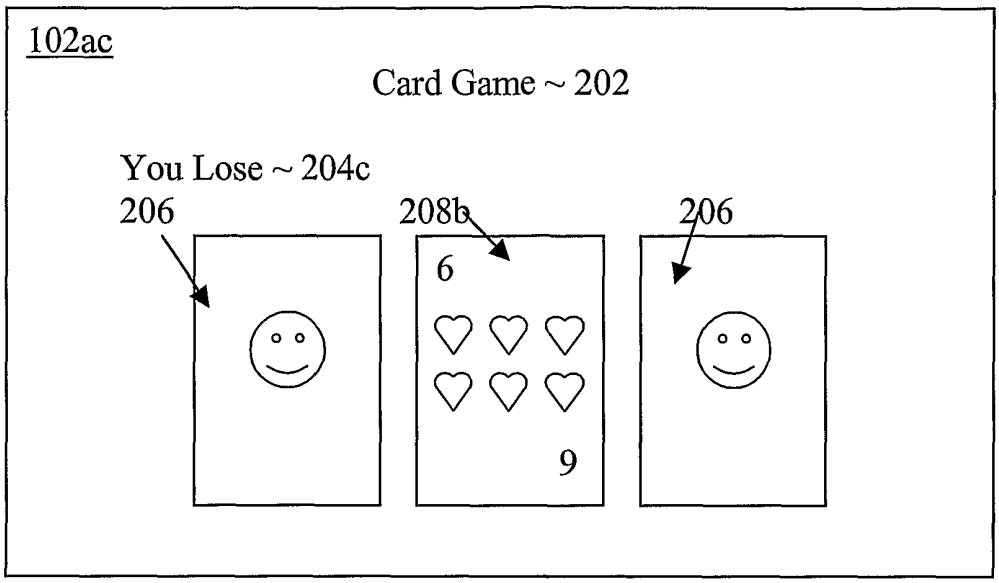

Figure 2c

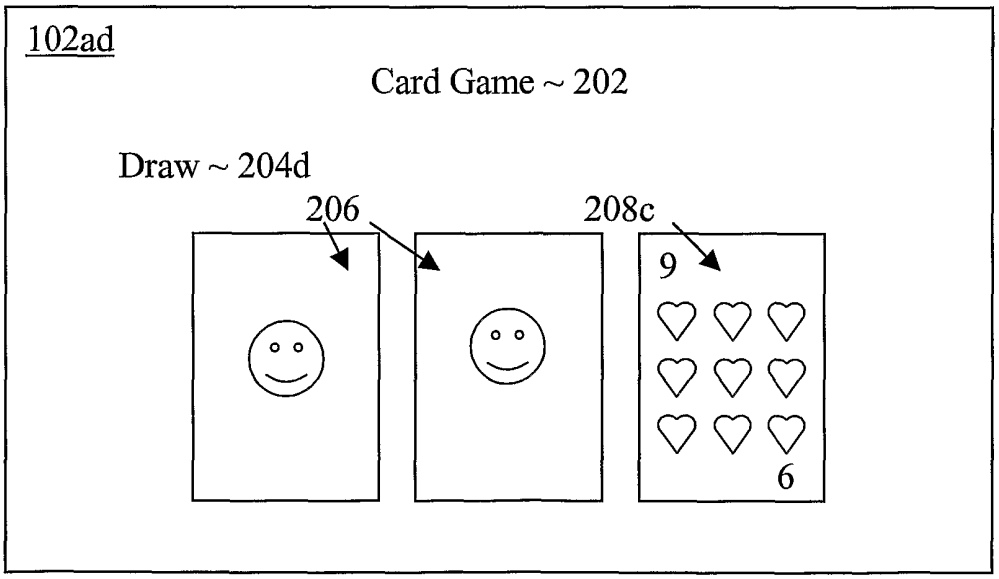

Figure 2d

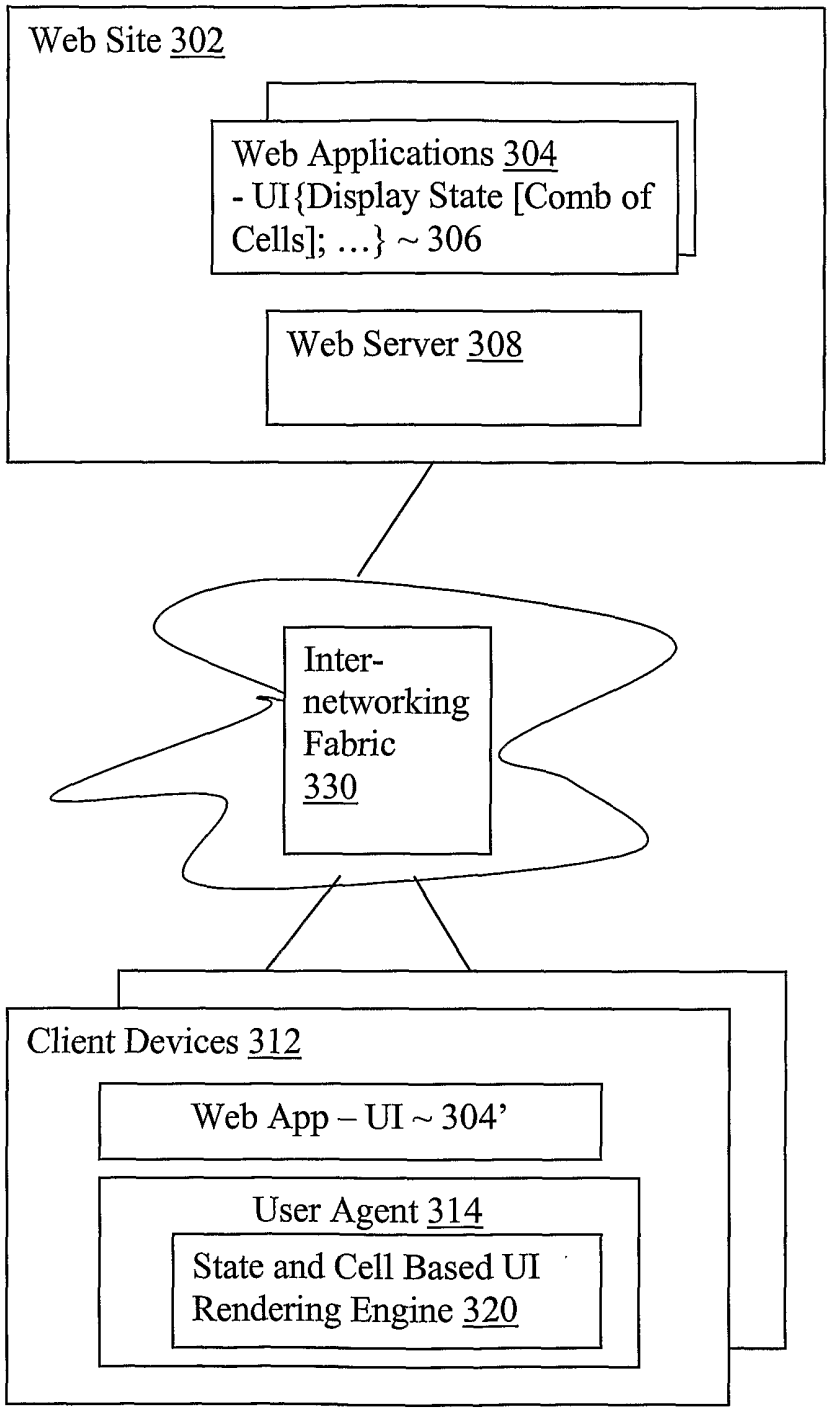
Web Site 302
Web Applications 304
- UI{Display State [Comb of Cells]; ...} ~ 306
Web Server 308
Inter-networking Fabric 330
Client Devices 312
Web App – UI ~ 304'
User Agent 314
State and Cell Based UI Rendering Engine 320

Figure 3

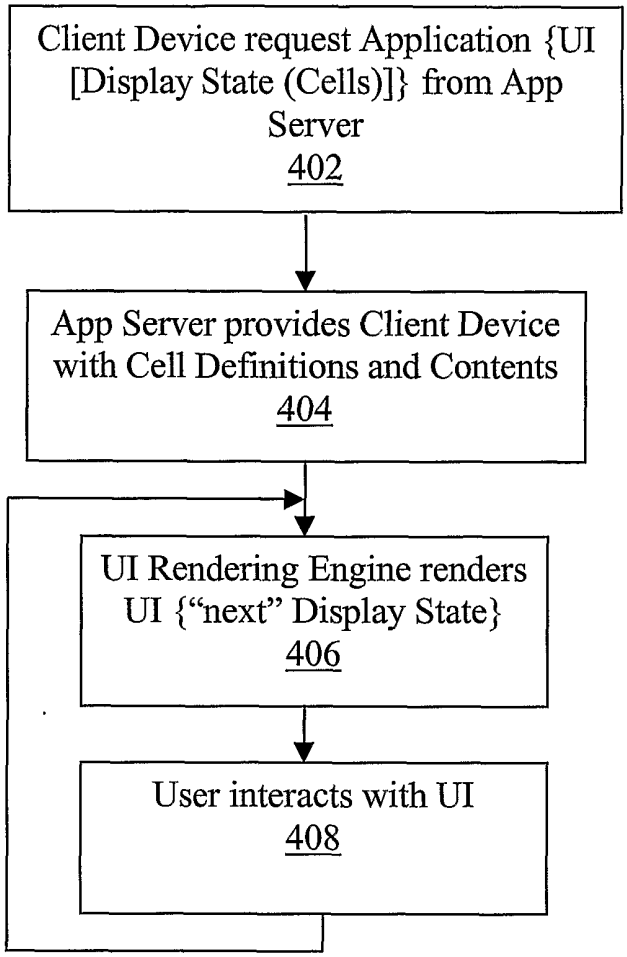
Client Device request Application {UI [Display State (Cells)]} from App Server
402
App Server provides Client Device with Cell Definitions and Contents
404
UI Rendering Engine renders UI {"next" Display State}
406
User interacts with UI
408

Figure 4

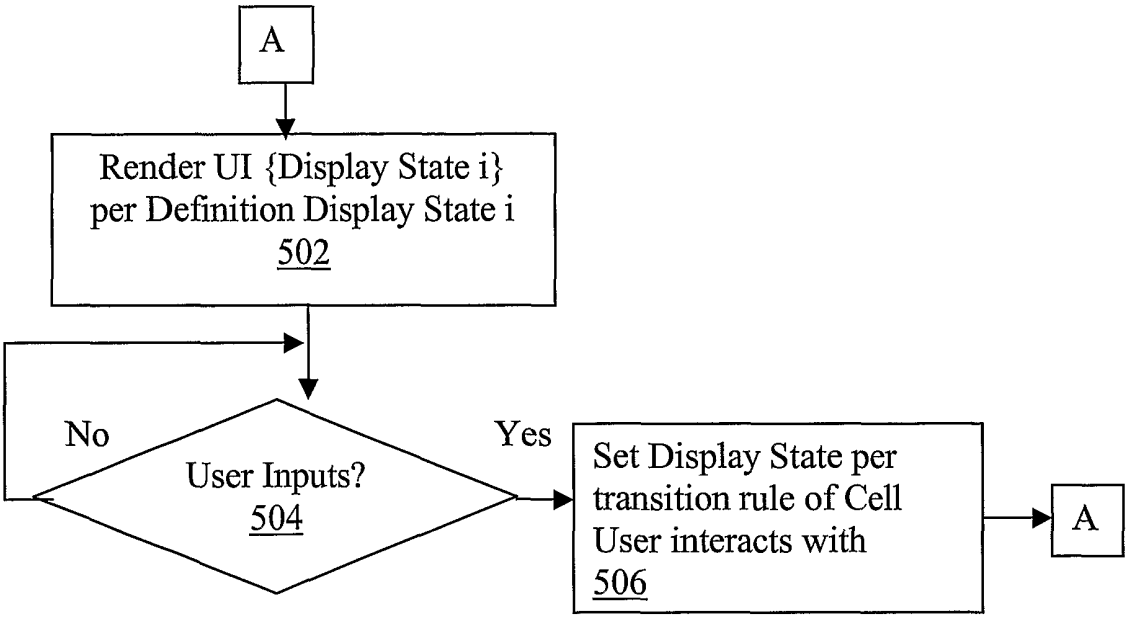

Figure 5a

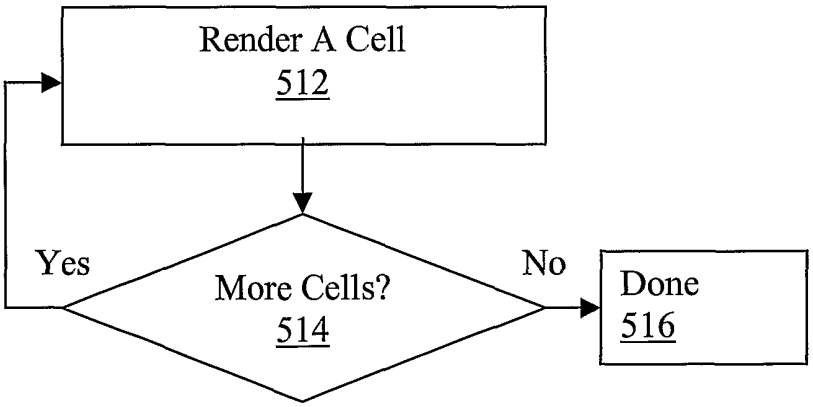

Figure 5b

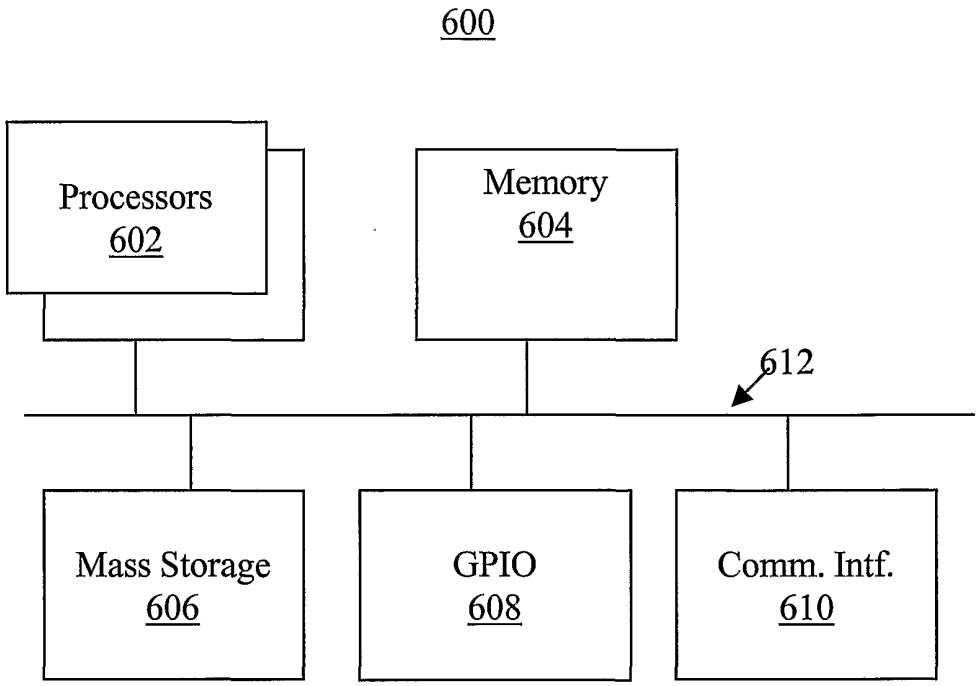
600
Processors
602
Memory
604
612
Mass Storage
606
GPIO
608
Comm. Intf.
610

Figure 6