A display adapter for docking one or more clients to a display and providing automatic mode switching of the display. The display adapter including a client interface circuit configured to receive client data from the one or more clients; a processing circuit configured to determine a display mode based on the client data; and a display interface circuit configured to transmit the display mode to the display.
DOCKING DISPLAY ADAPTER WITH AUTOMATIC MODE SWITCHING

FIELD

The present disclosure relates to docking display adapters, and more particularly, to docking display adapters with automatic display mode switching.

BACKGROUND

Display adapters or docking stations allow multiple clients to alternately connect to a display. Each client, however, may have a different display mode requirement. For example, an enterprise notebook PC client may be primarily interested in productivity and thus have a desired display mode that provides the highest quality text rendering possible on that display. Alternatively, a desktop gaming PC client may have, as a desired configuration, a gaming mode where image post-processing in the display is turned off to decrease latency.

Generally, when the display adapter switches from one client to another, a user must manually change the display mode and settings by pushing a sequence of buttons or using an infra-red (IR) remote control to issue commands to the display. This can be a cumbersome process, particularly when the clients are remote and coupled to the display adapter through a wireless connection.

BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of embodiments of the claimed subject matter will become apparent as the following Detailed Description proceeds, and upon reference to the Drawings, wherein like numerals depict like parts, and in which:

Figure 1 illustrates a top level system diagram of one exemplary embodiment consistent with the present disclosure;

Figure 2 illustrates a top level system diagram of another exemplary embodiment consistent with the present disclosure;

Figure 3 illustrates a system block diagram of one exemplary embodiment consistent with the present disclosure;

Figure 4 illustrates a data channel of one exemplary embodiment consistent with the present disclosure; and

Figure 5 illustrates a flowchart of operations of one exemplary embodiment consistent with the present disclosure.

Although the following Detailed Description will proceed with reference being made to illustrative embodiments, many alternatives, modifications, and variations thereof will be
apparent to those skilled in the art.

DETAILED DESCRIPTION

Generally, this disclosure provides an apparatus and method to automatically switch a display mode, and/or other settings associated with a display, in response to a change of clients connecting through a display adapter. In some embodiments the display adapter may be a wireless docking display adapter through which the clients may be remotely accessing the display. The wireless connection may be a Wireless Fidelity (Wi-Fi) connection, a 60 GHz connection or any other suitable wireless connection. In some embodiments the display adapter may be integrated with the display.

Figure 1 illustrates a top level system diagram 100 of one exemplary embodiment consistent with the present disclosure. A display adapter 102 serves as an interface between display 104 and clients 106, 108, 110. As the system switches from one client, for example client-1 106, to another, for example client-2 108, the display adapter 102 transmits a new display mode and/or other display settings to display 104. Display adapter 102 determines the new display mode and/or settings in a manner that will be explained in greater detail below. Display mode and settings may include, for example, contrast, brightness, and any other settings the display 104 may be capable of supporting or adjusting. In some embodiments, display adapter 102 may be a wireless display docking station.

Figure 2 illustrates a top level system diagram 200 of another exemplary embodiment consistent with the present disclosure. This embodiment is similar to that shown in figure 1, but illustrates that the display adapter 102 may be integrated with display 104.

Figure 3 illustrates a system block diagram 300 of one exemplary embodiment consistent with the present disclosure. Display adapter 102 is shown in greater detail to comprise client interface circuit 302, processor 304, memory 306 and display interface circuit 308. Display interface circuit 308 may communicate with display 104 through in-band channel 310 and/or out-of-band channel 312 as will be explained in greater detail below.

Client interface circuit 302 receives data from one of clients 106, 108, 110 that is currently connected to display adapter 102. This client data may comprise video data and control data. In some embodiments, the control data may include a client identification (ID). If a client ID is provided in the control data, the processor 304 may autonomously retrieve a desired display mode/setting associated with that client ID from memory 306. For example, the memory 306 may contain a list, or other suitable data structure, that pairs client IDs with a desired or default display mode/setting. The list or data structure maybe arranged to enable an efficient search so as to reduce the time required to find the display mode associated with the ID.
In some embodiments, the control data may include configuration setting messages comprising a requested display mode and/or other display settings, in which case the client is responsible for generating the messages. The messages may also comprise both a client ID and a display mode/setting, thus enabling the processor 304 to store the combination in memory 306 for future association.

Processor 304 may format the video data into a form suitable to the display 104. Display interface circuit 308 may transmit the desired display mode/setting along with the video data to display 104. In some embodiments, the display mode/setting may be transmitted in-band 310, for example on a channel, bus or video interface shared with the video data. Alternatively, the display mode/setting may be transmitted out-of-band 312, for example on a channel, bus or other interface that is separate from the video data.

In some embodiments, the client data may be received by client interface circuit 302 over a wireless connection. The wireless connection may be a Wi-Fi connection in accordance with any of the existing standards and/or future versions and/or derivatives thereof. The wireless connection may be configured to operate in the millimeter wave (mm-wave) region of the RF spectrum and, in particular, the 60 GHz region associated, for example, with the use of wireless personal area network (WPAN) and wireless local area network (WLAN) communication systems.

In some embodiments, the client data may be received by client interface circuit 302 over a wired display interface connection. The wired connection may comprise a High Definition Multimedia Interface (HDMI), a DisplayPort, a mechanical docking connection, a Universal Serial Bus (USB) or a wired local area network (LAN) operating in accordance with any of the existing standards and/or future versions and/or derivatives thereof.

An advantage of one more embodiments consistent with the present disclosure is that the display mode/setting for display 104 may be automatically updated as display adapter usage switches from one client to another, thus eliminating the need for manual adjustment of the settings through user interface commands on the display 104.

Figure 4 illustrates a data channel 400 of one exemplary embodiment consistent with the present disclosure. Shown, is an in-band 310 data stream where the display mode is transmitted along with the video data, interspersed on the same channel. Also shown, is an out-of-band 312 data stream where the display mode is transmitted on a channel separate from the video data.

Figure 5 illustrates a flowchart of operations 500 of one exemplary embodiment consistent with the present disclosure. At operation 510, client data is received from one or more clients. The clients are connected to a display adapter such as, for example, as wireless docking display adapter. At operation 520, a display mode is determined based on the client data. The
display mode be contained in the client data or the display mode may be determined based on an
association with a client ID that is contained in the client data. At operation 530, the display
mode is transmitted to a display.

According to one aspect of the disclosure, there is thus provided an apparatus for a
display adapter. The apparatus includes: a client interface circuit configured to receive client
data from one or more clients; a processing circuit configured to determine a display mode based
on the client data; and a display interface circuit configured to transmit the display mode to a
display. The display interface circuit is further configured to embed the display mode within a
video signal transmitted to the display and/or to transmit the display mode through a channel to
the display which is separate from a video signal channel. The display adapter further includes a
memory circuit and the processing circuit is further configured to associate a client identification
with the display mode, where the client identification is included in the client data and the
association is obtained from the memory circuit. The processing circuit is further configured to
extract the display mode from a configuration settings message included in the client data. The
client interface circuit may be further configured to receive the client data through a wireless
receiver which may operate in accordance with a Wi-Fi standard and/or in a millimeter wave
frequency range. The client interface circuit may also be configured to receive the client data
through a wired interface such as a High Definition Multimedia Interface (HDMI), a
DisplayPort, a mechanical docking connection, a Universal Serial Bus (USB) or a wired local
area network (LAN). The display adapter may be integrated in the display.

According to another aspect of the disclosure, there is provided a method for interfacing a
client to a display. The method includes: receiving client data from one or more clients;
determining a display mode based on the client data; and transmitting the display mode to a
display. The method further includes embedding the display mode within a video signal
transmitted to the display and/or transmitting the display mode through a channel to the display
which is separate from a video signal channel. The method further includes associating a client
identification with the display mode, the client identification included in the client data. The
method further includes extracting the display mode from a configuration settings message, the
configuration setting message included in the client data. The method may further include
receiving the client data wirelessly in accordance with a Wi-Fi standard and/or in a millimeter
wave frequency range. The method may further include receiving the client data through a wired
interface such as a High Definition Multimedia Interface (HDMI), a DisplayPort, a mechanical
docking connection, a Universal Serial Bus (USB) or a wired local area network (LAN).

Embodiments of the methods described herein may be implemented in a system that
includes one or more storage mediums having stored thereon, individually or in combination,
instructions that when executed by one or more processors perform the methods. Here, the processor may include, for example, a system CPU (e.g., core processor) and/or programmable circuitry. Thus, it is intended that operations according to the methods described herein may be distributed across a plurality of physical devices, such as processing structures at several different physical locations. Also, it is intended that the method operations may be performed individually or in a subcombination, as would be understood by one skilled in the art. Thus, not all of the operations of each of the flow charts need to be performed, and the present disclosure expressly intends that all subcombinations of such operations are enabled as would be understood by one of ordinary skill in the art.

The storage medium may include any type of tangible medium, for example, any type of disk including floppy disks, optical disks, compact disk read-only memories (CD-ROMs), compact disk rewritables (CD-RWs), digital versatile disks (DVDs) and magneto-optical disks, semiconductor devices such as read-only memories (ROMs), random access memories (RAMs) such as dynamic and static RAMs, erasable programmable read-only memories (EPROMs), electrically erasable programmable read-only memories (EEPROMs), flash memories, magnetic or optical cards, or any type of media suitable for storing electronic instructions.

"Circuitry", as used in any embodiment herein, may comprise, for example, singly or in any combination, hardwired circuitry, programmable circuitry, state machine circuitry, and/or firmware that stores instructions executed by programmable circuitry.

The terms and expressions which have been employed herein are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described (or portions thereof), and it is recognized that various modifications are possible within the scope of the claims. Accordingly, the claims are intended to cover all such equivalents. Various features, aspects, and embodiments have been described herein. The features, aspects, and embodiments are susceptible to combination with one another as well as to variation and modification, as will be understood by those having skill in the art. The present disclosure should, therefore, be considered to encompass such combinations, variations, and modifications.
CLAIMS

What is claimed is:

1. A display adapter, comprising:
   a client interface circuit configured to receive client data from one or more clients;
   a processing circuit configured to determine a display mode based on said client data; and
   a display interface circuit configured to transmit said display mode to a display.

2. The display adapter of claim 1, wherein said display interface circuit is further configured to embed said display mode within a video signal transmitted to said display.

3. The display adapter of any of claims 1 or 2, wherein said display interface circuit is further configured to transmit said display mode through a channel to said display, said channel separate from a video signal channel.

4. The display adapter of any of claims 1 to 3, further comprising a memory circuit and wherein said processing circuit is further configured to associate a client identification with said display mode, said client identification included in said client data and said association obtained from said memory circuit.

5. The display adapter of any of claims 1 to 4, wherein said processing circuit is further configured to extract said display mode from a configuration settings message, said configuration setting message included in said client data.

6. The display adapter of any of claims 1 to 5, wherein said client interface circuit is further configured to receive said client data through a wireless receiver.

7. The display adapter of claim 6, wherein said wireless receiver is configured to operate with a Wireless Fidelity (Wi-Fi) interface.

8. The display adapter of any of claims 6 or 7, wherein said wireless receiver is configured to operate in a millimeter wave frequency range.

9. The display adapter of any of claims 1 to 8, wherein said display adapter is integrated in said display.
10. The display adapter of any of claims 1 to 5, wherein said client interface circuit is further configured to receive said client data through a wired interface.

11. The display adapter of claim 10, wherein said wired interface is a High Definition Multimedia Interface (HDMI), a DisplayPort, a mechanical docking connection, a Universal Serial Bus (USB) and/or a wired local area network (LAN).

12. A method for interfacing a client to a display, comprising:
   receiving client data from one or more clients;
   determining a display mode based on said client data; and
   transmitting said display mode to a display.

13. The method of claim 12, further comprising embedding said display mode within a video signal transmitted to said display.

14. The method of any of claims 12 or 13, further comprising transmitting said display mode through a channel to said display, said channel separate from a video signal channel.

15. The method of any of claims 12 to 14, further comprising associating a client identification with said display mode, said client identification included in said client data.

16. The method of any of claims 12 to 15, further comprising extracting said display mode from a configuration settings message, said configuration setting message included in said client data.

17. The method of any of claims 12 to 16, wherein said client data is received wirelessly.

18. The method of claim 17, wherein said wireless reception is through a Wi-Fi interface.

19. The method of any of claims 17 or 18, wherein said wireless reception operates in a millimeter wave frequency range.

20. The method of any of claims 12 to 16, wherein said client data is received through a wired interface.
21. The method of claim 20, wherein said wired interface is a High Definition Multimedia Interface (HDMI), a DisplayPort, a mechanical docking connection, a Universal Serial Bus (USB) and/or a wired local area network (LAN).

22. At least one computer accessible medium storing instructions which, when executed by a machine, cause the machine to perform the steps of a method as claimed in any of claims 12 to 21.
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FIG. 4
500

510
Receive client data from one or more clients

520
Determine a display mode based on the client data

530
Transmit the display mode to a display

FIG. 5
A. CLASSIFICATION OF SUBJECT MATTER

G06F 13/14(2006.01)i, G06F 13/38(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F 13/14; G06F 15/16; G09B 19/00; G06T 11/00; G06F 3/00; G06F 17/00; G06F 3/01

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPo internal) & Keywords: multi, user, display, similar, terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>US 2005-0198578 A1 (MANEESH AGRAWALA et al.) 08 September 2005</td>
<td>1,2,7,11-13,18,21</td>
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<td>See paragraphs [0038]-[0071]; claim 1; and figures 2-3.</td>
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<td>US 2009-0287832 A1 (MIKE CHIH-KANG LIANG et al.) 19 November 2009</td>
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<td>See paragraphs [0029]-[0052]; and figures 2, 4.</td>
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 Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason as specified

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search


Date of mailing of the international search report


Name and mailing address of the ISA/KR

Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer

LEE, Seok Hyung
Telephone No. 82-42-481-5983

Form PCT/ISA/210 (second sheet) (July 2009)
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*Form PCT/ISA/210 (patent family annex) (July 2009)*
### Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 4-6, 8-10, 15-17, 19-20, 22
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☑ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☑ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☑ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  

#### Remark on Protest

☐ The additional search fees were accompanied by the applicant’s protest and, where applicable, the payment of a protest fee.

☒ The additional search fees were accompanied by the applicant’s protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.