US006559773B1

(12) **United States Patent**
Berry

(10) **Patent No.: US 6,559,773 B1**
(45) **Date of Patent: May 6, 2003**

(54) **RECONFIGURABLE DISPLAY ARCHITECTURE WITH SPONTANEOUS RECONFIGURATION**

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

(21) Appl. No.: **09/468,170**

(22) Filed: **Dec. 21, 1999**

(51) **Int. Cl.**[7] **G08B 5/00**

(52) **U.S. Cl.** **340/815.4**; 340/531; 701/29; 701/33; 700/17; 700/83; 345/326

(58) **Field of Search** 340/815.4, 531; 701/29, 33; 700/17, 83; 345/326

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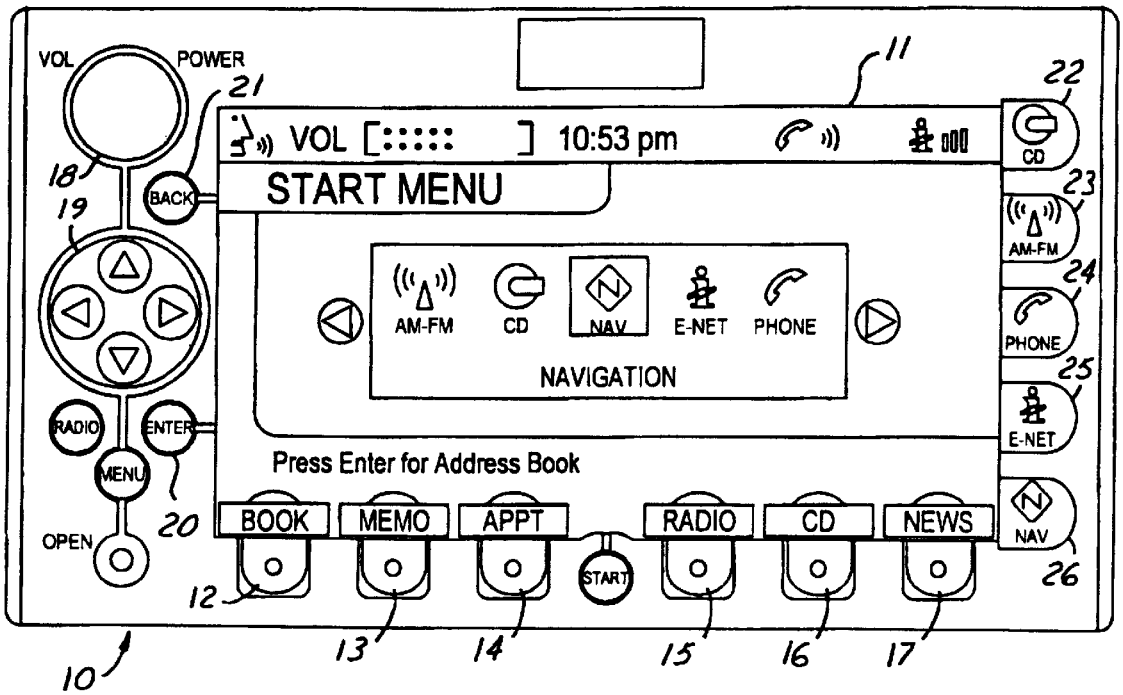
(57) **ABSTRACT**

A control panel/display subsystem acts as a device portal for interacting with multiple devices interconnected via a dynamic local network. Display content and the human-machine interface (HMI) implemented using the display subsystem automatically reconfigures itself when new devices are added to the vehicle network. An interface specifier enabling each new device to work with the device portal is obtained either from a local archive or a remote archive via connection with a remote network.

18 Claims, 3 Drawing Sheets



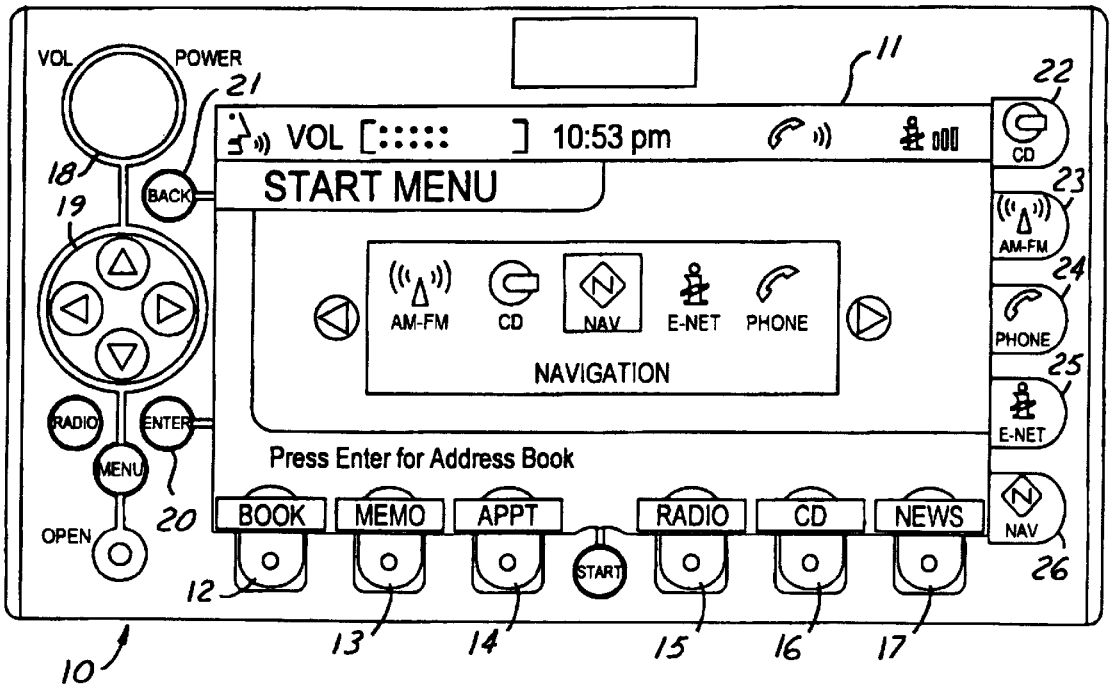


FIG. 1

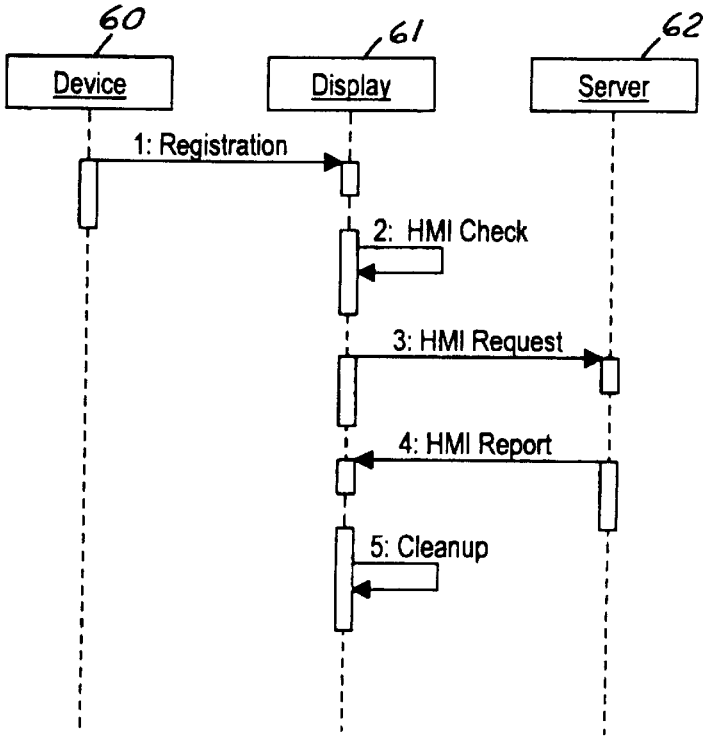


FIG. 4

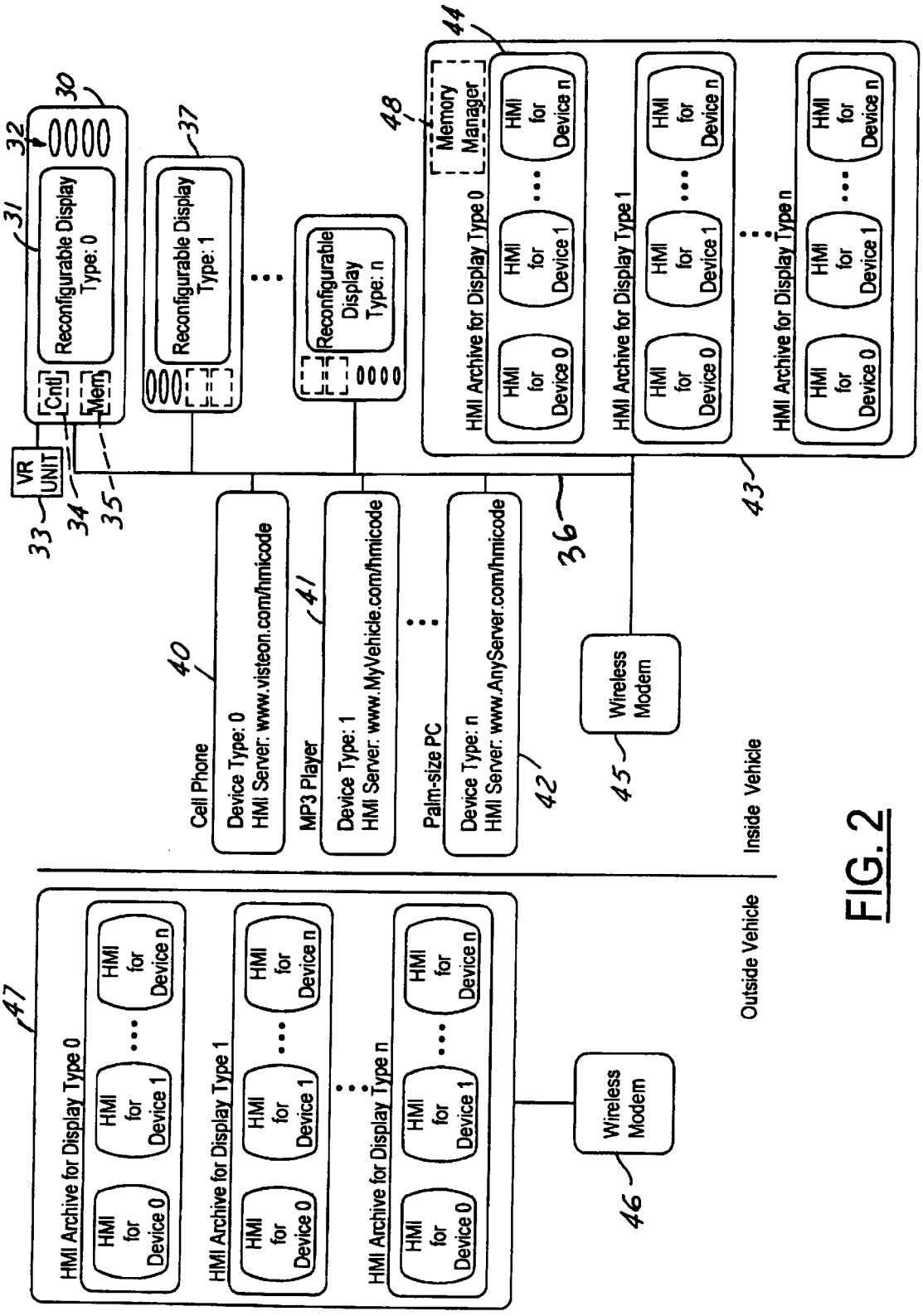


FIG. 2

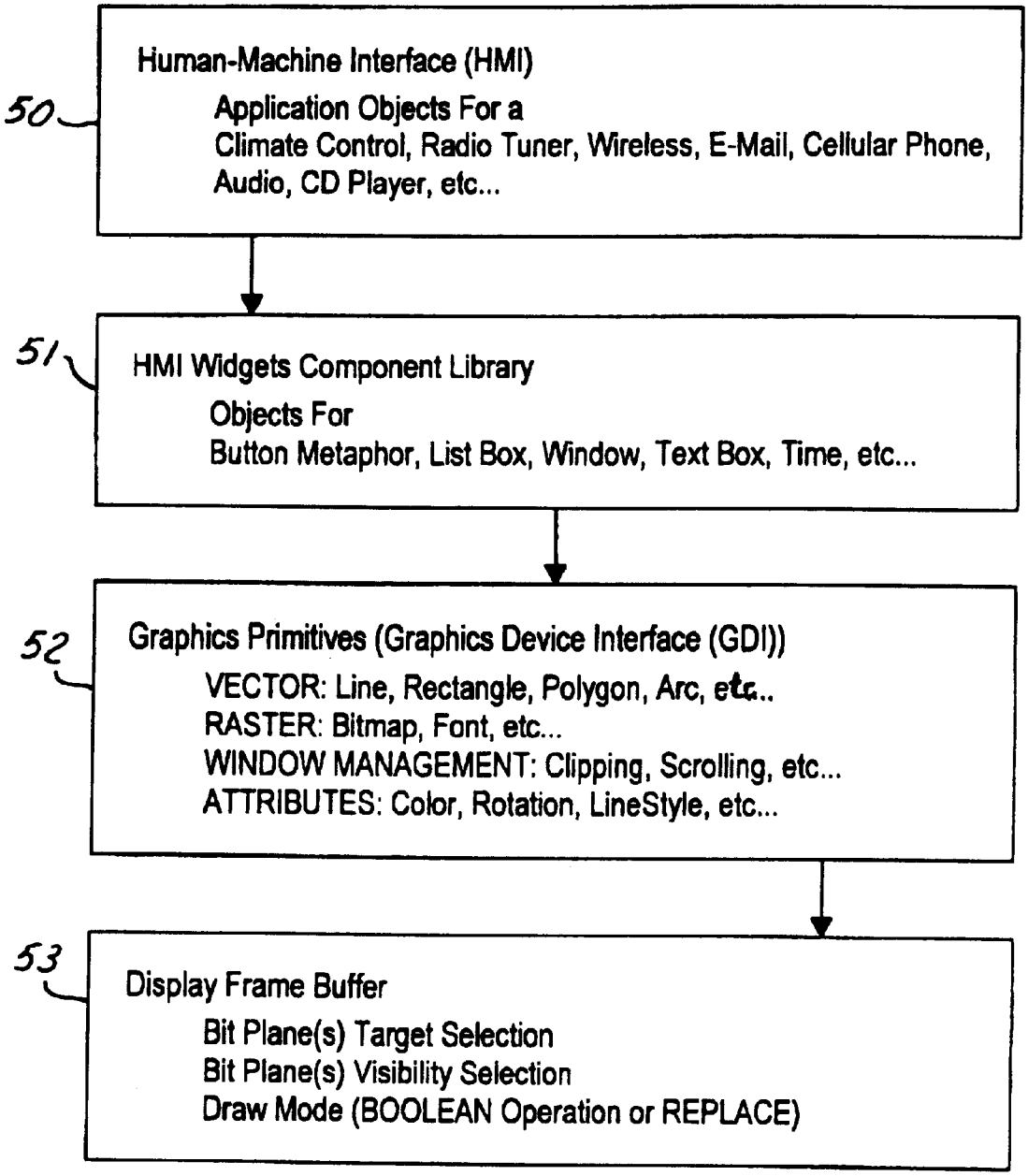


FIG. 3

RECONFIGURABLE DISPLAY ARCHITECTURE WITH SPONTANEOUS RECONFIGURATION

BACKGROUND OF THE INVENTION

The present invention relates in general to a reconfigurable display/control panel for controlling various electronic accessories, and more specifically to an architecture for reconfigurable displays and an overall network for spontaneously interconnecting the displays with various electronic accessories or devices in a manner which automatically reconfigures menu elements shown on the reconfigurable display to interact with each electronic accessory.

Reconfigurable displays are used in automotive vehicles in order to control a plurality of electronic accessories from a single control panel. Such a system reduces cost, saves space on the vehicle instrument panel, and makes the electronic accessories easier to control. A reconfigurable display includes a generic graphic display surface, such as a dot matrix, and a collection of "soft keys" (i.e., programmable buttons). The function of each key is dynamically reconfigured via software to allow access to all the available functions or the accessories, typically using a menu structure. A typical reconfigurable display subsystem may also include a number of "hard keys", buttons that provide instant access to frequently used functions (e.g., navigation, climate control, audio players, etc.).

Because of their generic, reusable nature, reconfigurable automotive displays have facilitated an increase in the number of features that are made available to the user. Consumers are demanding ever-greater functionality from their electronic accessories, while product design cycles of the accessories are simultaneously becoming shorter. Thus, it becomes a major challenge for manufacturers to provide new and innovative system architectures while delivering high content, high quality products and features at a reasonable cost.

First generation automotive reconfigurable display systems utilize embedded architectures that build specific feature content into the display design that cannot be altered or augmented after the design is implemented. All supported features must be identified at the time of initial design. While this approach provides high performance and low cost, it lacks flexibility.

Second generation automotive reconfigurable display systems utilize a personal computer (PC) type of architecture, such as the AutoPC platform. Such systems enable incremental feature deployment, wherein new features can be integrated seamlessly with those already present. However, such feature deployment is essentially a static model since installed software applications occupy a percentage of the display resources at all times. Thus, it is distinctly possible that system resources could be inadvertently depleted during installation of a new feature. Furthermore, such customization requires installation skills on the part of the users (not just system developers and integrators), which limits the utility of such customization for a significant percentage of customers. Such systems are not truly "plug-and-play" since a manual installation procedure is required.

SUMMARY OF THE INVENTION

The present invention has the advantage of providing a reconfigurable display architecture in which a human-machine interface (HMI) is dynamically constructed in response to the electronic accessories which are present in the system.

In one aspect of the invention, an electronic accessory display/control system is provided for a transportation vehicle. A reconfigurable control panel has a visual display for displaying menu items for an electronic accessory and has at least one control actuator. A human-machine interface controller is coupled to the reconfigurable control panel and includes a local archive for storing a plurality of interface specifiers. Each specifier defines interaction between the reconfigurable control panel and a respective electronic accessory for performing operations via the menu items using a predetermined communications protocol. The system includes an expandable interconnection link for coupling compatible electronic accessories with the human-machine interface controller. A wireless transceiver is provided for accessing a remote archive of interface specifiers. The remote archive includes interface specifiers each adapted for a corresponding combination of a particular electronic accessory and a particular reconfigurable control panel. The human-machine interface controller responds to a coupling of an electronic accessory to the expandable interconnection link by checking the local archive for presence of a desired interface specifier corresponding to the electronic accessory and the reconfigurable control panel. If the desired interface specifier is not present in the local archive, then the wireless transceiver is activated to automatically obtain the desired interface specifier from the remote archive.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front, plan view of a reconfigurable display employing the present invention.

FIG. **2** is a schematic diagram showing the overall network system of the present invention.

FIG. **3** is a block diagram showing the interaction of software objects for forming a human-machine interface and its interaction with the reconfigurable display.

FIG. **4** illustrates the main tasks executed when a new device is joined into the vehicle network.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention creates a device portal within a network architecture having a dynamically constructed human-machine interface (HMI). A control panel/display subsystem includes a collection of hard and soft controls and is made available as a network resource on a dynamic local network. The display subsystem of the device portal may include standard embedded features such as an audio tuner or CD player, but its main purpose is to be dynamically reconfigurable to interact with other network resources via a collection of standard protocols. These other network resources include devices such as a navigation system, cellular phone, audio player, a palm-size PC, or any other device employing an HMI in the vehicle. These devices need not be present in the network at all times. Using Java/Jini technology or similar technology, a dynamic network can be constructed which allows automatic installation of devices into the network.

Referring to FIG. **1**, a control panel/display subsystem **10** includes a multi-element graphical display **11**. A plurality of push buttons **12–17** provide soft keys for accessing functions as identified by graphic/text labels displayed on display screen **11**. Hard controls include a knob **18** which is pressed to control system power and can be rotated to control audio volume. An arrow pad **19** is used to navigate through menus displayed on display screen **11**. An enter button **20** and a

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