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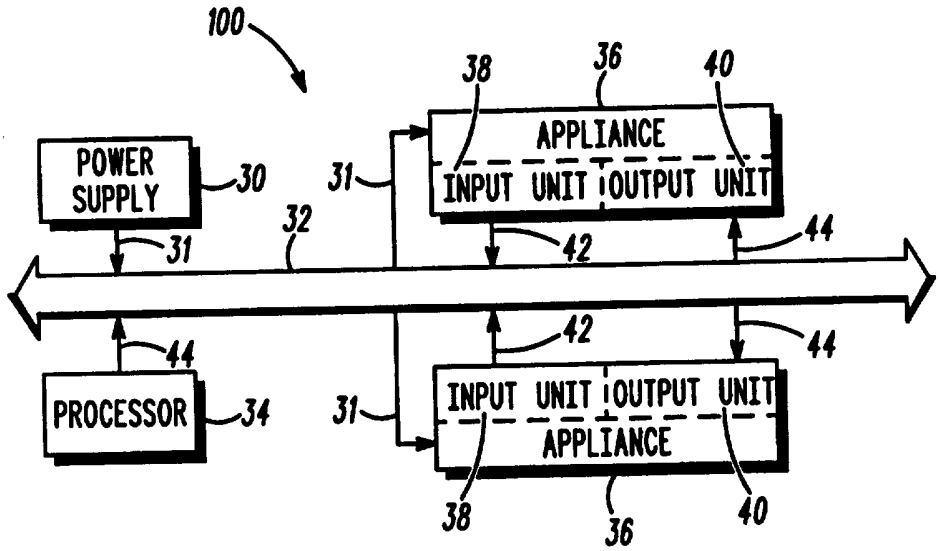
(54) Title: PROCESSOR SYSTEM AND METHOD FOR APPLIANCES

(57) Abstract

A processor system (100) provides electrical power and processing to a plurality of appliances. A data bus (32) receives a control input signal from each of the plurality of appliances (36) and transfers electrical power (31) and output command signals (44) to each of the plurality of appliances (36). A processor (34), coupled to the data bus (32), generates an output command signal (44) for each of the plurality of appliances (36) in response to the input control signals (42).



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PROCESSOR SYSTEM AND METHOD FOR APPLIANCES

Cross Reference to Related Invention

The present invention is related to the following invention which is assigned to the same assignee, Motorola, Inc., as the present invention:

Neural Network and Method of Using Same, having Serial No. 08/076,601, filed on June 14, 1993.

The subject matter of the above-identified application is hereby incorporated by reference into the disclosure of this invention.

Field of the Invention

The present invention relates to appliances and, in particular, to processors used in appliances.

Background of the Invention

One's home is currently filled with many appliances which are "smart". FIG. 1 shows a block diagram of the essential components of a typical prior art appliance. Examples of smart appliances include computers, television sets, VCRs, washing machines, dryers, refrigerators, dishwashers, coffee makers, vacuum cleaners, etc. Each smart appliance 10 contains one or more processors 16 as well as some form of input unit 12 and output unit 14 for performing the functions for which they were designed. For instance, the components and functions of a television set can be broken down as shown in Table I.

TABLE I

Input Units:

* RF signal input;
* User control inputs (volume, brightness, channel, etc.);

Output Units:

* Speakers and amplifiers;
* Picture tube;

Functions Performed by the Processor:

* Demodulation and tuning;
* Picture quality control;
* Control based on control inputs;
* Etc.;

It should be noted that the processors are, in general, operating extremely inefficiently. At any given time, most of these processors are either switched off or waiting for further input. These processors are performing real functions only a small percentage of the time.

A further problem with many smart devices found in the home is that they each require a power supply 18 which converts the 120VAC power supplied to the house into the low voltage DC power required to operate. These power supplies are heavy and bulky and add substantial cost to these devices.

Brief Description of the Drawings

The invention is pointed out with particularity in the appended claims. However, other features of the invention will become more apparent and the invention will be best understood by referring to the following detailed description in conjunction with the accompanying drawings in which:

FIG. 1 shows a block diagram of the essential components of a typical prior art appliance.

FIG. 2 shows a block diagram of one embodiment of the system of the present invention.

FIG. 3 shows an example of the processor system of a further embodiment of the present invention installed in a building such as a house.

FIG. 4 shows a schematic representation of the processor used in one embodiment of the present invention.

FIG. 5 shows a flow chart representation of a method of determining control coefficients for a processor in accordance with one embodiment of the present invention.

FIG. 6 presents a flowchart representation of a method of operating the plurality of appliances in accordance with one embodiment of the present invention.

FIG. 7 presents a flowchart representation of a method of operating the plurality of appliances in accordance with an alternative embodiment of the present invention.

Detailed Description of a Preferred Embodiment

The present invention provides a central processor for providing processing power for distribution to a series of "dumb" appliances via a processing bus. The resulting appliances are thus less expensive than their "smart" counterparts. Further, the connection to a common bus allows interaction between devices to be easily effectuated through a central processor.

FIG. 2 shows a block diagram of one embodiment of the system of the present invention. The present invention provides a processor system 100 for a plurality of appliances 36. Each of the plurality of appliances 36 has an input unit 38 which generates at least one control input signal 42 and an output unit 40 responsive to at least one output command signal 44.

A power supply 30 is provided for supplying electrical power over conductor 31. A data bus 32 coupled to the plurality of appliances 36 and the power supply 30 is also provided for receiving the control input signal 42 from each of the plurality of appliances 36, and for transferring electrical power over conductor 31 and output command signals 44 to each of the plurality of appliances 36. A processor 34, coupled to the

data bus 32 and responsive to the received control input signals 42, is provided for generating the output command signal 44 for each of the plurality of appliances.

In one embodiment of the present invention, the electrical power over conductor 31 supplied by power supply 30 includes a low voltage direct current of in the range of 12 to 24 volts. However, one skilled in the art will recognize that other ranges or forms of electrical power, such as 112 VAC or 220 VAC etc. could also be used.

FIG. 3 shows an example of the processor system of a further embodiment of the present invention installed in a building such as a house. Processing system 100 includes processor 120 connected to data bus 122. This data bus 122 is incorporated into the walls of the house in a similar fashion to traditional home wiring for telephone, power, cable television, etc. "Dumb" appliances are shown, such as VCR 124, television 126 and coffee maker 128. Further, cable television line 132 and telephone line 134 are also connected to the data bus 122.

Power supply 130 is further connected to data bus 122 in order to supply power to "dumb" appliances 124, 126 and 128.

In one embodiment of the present invention, this data bus 122 is implemented using a coaxial cable of other transmission line. In this fashion, homes with existing transmission lines installed, such as cable television lines can be modified to operate with the present invention without the provision of additional wiring.

In one embodiment of the present invention, this power supply 130 supplies 16 volts DC to "dumb" appliances 124, 126 and 128 for regulation down to 12 or 5 volts as required by or at the individual units.

An example of the operation of processing system 100 can be described in terms of television 126. This television 126 contains input units to receive cable television signals supplied by data bus 122, a picture tube for providing a visual display, and speakers for providing an audio output. This television could also contain buttons for indicating various user control inputs (volume, brightness, channel, etc.);

however, a common bus remote control (not shown), which supplies information to the bus, could also be used to control the operation of television 126. The processing functions which would normally be resident within the television 126 are performed by processor 120. Thus, much of the circuitry, which one would normally expect, would not be needed. When a user indicates a change of channel is desired by pressing a button on the television 126 or by means of a speech recognizer used in conjunction with television 126, a television remote control or bus remote control, a control input signal, such as a digital voltage signal, is generated. This control input signal is transferred to the processor 120.

In one embodiment of the present invention, the processor 120, in turn, generates an appropriate output command signal, such as a digital signal, to television 126 to command the television 126 change the channel.

In an alternative embodiment of the present invention, the processor 120 itself includes a tuner and selects the new channel. In this alternative embodiment, the composite video signal corresponding to the new channel is selected via processor 120 and is routed to television 126 via bus 122. Further, some of the power to the unit, the necessary low-voltage DC power, would also be supplied by data bus 122 from power supply 130.

Further, the programming of the appliances could be performed via the processor 120. In this fashion, the time/date clocks of each device could be programmed simultaneously and the coordinated operation of different devices could be effectuated.

FIG. 4 shows a schematic representation of the processor used in a preferred embodiment of the present invention. This processor 34 calculates output command signals as a polynomial function of one or more control input signals. A plurality of control input signals, x_1, x_2, . . ., x_n are fed to input nodes 176, 178, . . . 180 of an input layer. The output of each input node 176, 178, . . . 180 in the input layer is distributed at least one processing element of a hidden layer (of which only processing elements 182, 184, 186 are shown). Each processing

element applies a gating function to each of the control inputs to produce a corresponding gated input. Any given processing element may apply a different gating function to each different control input it receives. For example, processing element 182 applies a gating function (g_{11}) to the control input it receives from input node 176; it applies a gating function (g_{21}) to the control input it receives from input node 78; and so forth. The gated inputs are multiplied together by a multiplier in the processing element to form a product, which is then multiplied by a control coefficient w_{i-1} to form the ith term of the polynomial. The ith term of the polynomial is added to the other, similarly calculated, terms by summer 188 to produce the control output y.

For example, in FIG. 4 processing element 182, which happens to be responsible for generating the first polynomial term, multiplies its gated inputs together to form a product (which happens to be one because in this case the gating functions g_{11}, g_{21}, . . . g_{n1} are all 0), which is multiplied by a control coefficient w_o to produce a corresponding output w_o. Processing element 184, which happens to be responsible for generating the w_1 x_1 term of the polynomial, multiplies its gated inputs together to form a product (which happens to be x_1 because in this case the gated functions are all 0 except for the gating function that is applied to the x_1 output of the input node 176), which is multiplied by a control coefficient w_1 to produce a corresponding output x_1 w_1. In like fashion, processing element 186 produces an output w_{n-1} x_1 to the power of g_{1n}, x_2 to the power of g_{2n} , . . ., x_n to the power of g_{nN}. The outputs of processing elements 182, 184, . . . 186 are summed together by a suitable summing means or function, such as summer 188, in an output layer to produce the output command signal y of the processor as follows:

$$y = \sum_{i=1}^{m} w_{i-1} \quad x_1^{g_{1i}} \quad x_2^{g_{2i}} \ . \ . \ . \ x_n^{g_{ni}} \qquad (1)$$

where m is an integer which represents the number of terms in the polynomial.

FIG. 5 shows a flow chart representation of a method of determining control coefficients for a processor in accordance with FIG. 4 in one embodiment of the present invention. First, regarding box 169, the control transfer characteristic data are provided. Next, regarding box 170, the number of data is compared with the number of control coefficients. Regarding decision box 171, if the number of data equal the number of control coefficients, the procedure goes to box 172 which indicates that a matrix inversion technique is used to solve for the initial value of each coefficient. If, on the other hand, the number of data is not equal to the number of control coefficients, the procedure goes to box 173, which indicates that a least squares estimation technique is used to solve for the initial value of each coefficient.

While a preferred embodiment is described herein, one with ordinary skill-in-the-art will recognize that other suitable estimation techniques, for example, extended least squares, pseudo inverse, Kalman filtering techniques, maximum likelihood techniques, Bayesian estimation, polynomial splines, and alike, could likewise be used to fit the control polynomial to the control transfer characteristic data.

FIG. 6 presents a flowchart representation of a method of operating the plurality of appliances in accordance with one embodiment of the present invention. The method begins by generating electrical power using a power supply as shown in step 200. The control input signal from each of the plurality of appliances are received as shown in step 202. The output command signal for each of the plurality of appliances are generated as shown in step 204. The electrical power and the output command signal are transferred to each of the plurality of appliances as shown in step 206.

FIG. 7 presents a flowchart representation of a method of operating the plurality of appliances in accordance with an alternative embodiment of the present invention. The method begins by generating electrical power using a power supply as shown in step 220. A control signal is generated for each appliance in response to an action of a user as shown in step

222. The control input signal from each of the plurality of appliances are received as shown in step 224. The output command signal for each of the plurality of appliances are generated as shown in step 226 based on the computation of a polynomial function of the control input signals, the polynomial function having a plurality of control coefficients. The electrical power and the output command signal are transferred to each of the plurality of appliances as shown in step 228.

Thus there has been described herein a concept, as well as several embodiments including a preferred embodiment, of a processor system and method for supplying electrical power and processing to a plurality of appliances.

Because the various embodiments of the present invention provide a central source for processing and electrical power to appliances, these appliances can be lighter and less costly and the processing can be performed more efficiently.

While the present invention has been described for use with home appliances, office appliances could similarly benefit from the invention. Thus, the invention described herein will likewise apply to office equipment such as word processors, copy machines, facsimile machines, telephones, printers and other computer peripheral devices.

It will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than the preferred form specifically set out and described above.

Accordingly, it is intended by the appended claims to cover all modifications of the invention which fall within the true spirit and scope of the invention.

Claims

1. A processor system for a plurality of appliances, each of the plurality of appliances having an input unit that generates a control input signal and an output unit responsive to an output command signal, the system comprising:

a power supply for supplying electrical power;

a data bus, coupled to the plurality of appliances and the power supply, for receiving the control input signal from each of the plurality of appliances, and for transferring electrical power and output command signals to each of the plurality of appliances; and

a processor, coupled to the data bus and responsive to the control input signals, for generating the output command signal for each of the plurality of appliances.

2. The system of claim 1 wherein the electrical power includes a low voltage direct current.

3. The system of claim 1 wherein the control input signals are generated by each appliance in response to an action of a user.

4. The system of claim 1 wherein the system is installed in a building.

5. The system of claim 1 wherein the data bus is coupled to a telephone line.

6. The system of claim 1 wherein the data bus is coupled to a cable television line.

7. The system of claim 1 wherein the output command signal is generated based upon a polynomial function of the control input signals, the polynomial function having a plurality of control coefficients.

8. The system of claim 7 wherein a value for each of the plurality of control coefficients is calculated using a least squares method.

9. The system of claim 7 wherein a value for each of the plurality of control coefficients is calculated using a matrix inversion technique.

10. In a processor system for a plurality of appliances, each of the plurality of appliances having an input unit that generates a control input signal and an output unit responsive to an output command signal, a method of operating the appliance, the method comprising the steps of:

generating electrical power using a power supply;

receiving the control input signal from each of the plurality of appliances;

generating the output command signal for each of the plurality of appliances; and

transferring the electrical power and the output command signal to each of the plurality of appliances.

FIG.1

—PRIOR ART—

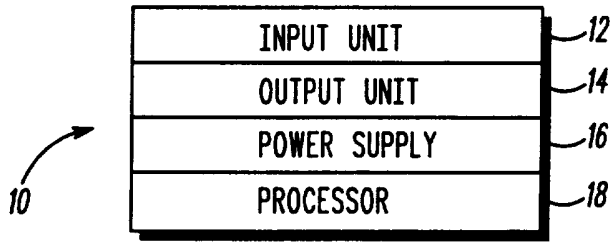
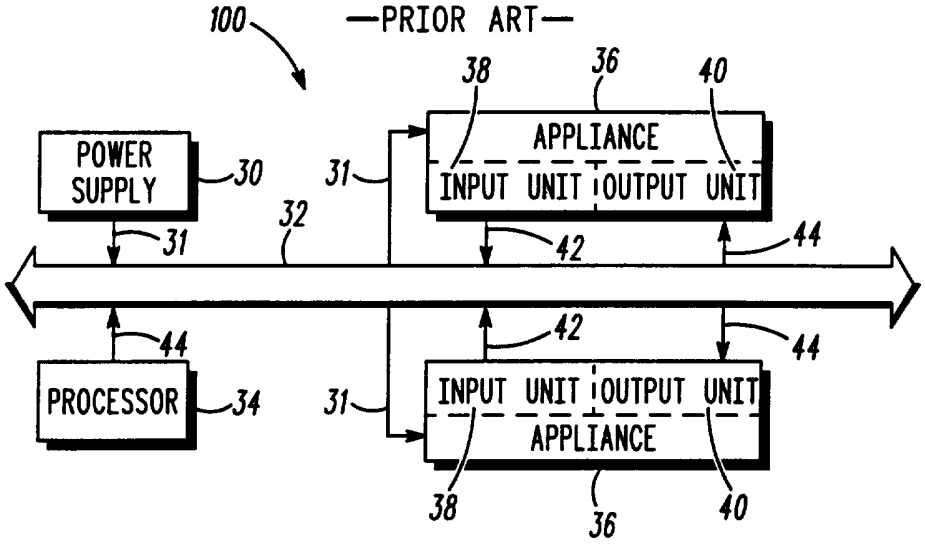


FIG.2

—PRIOR ART—



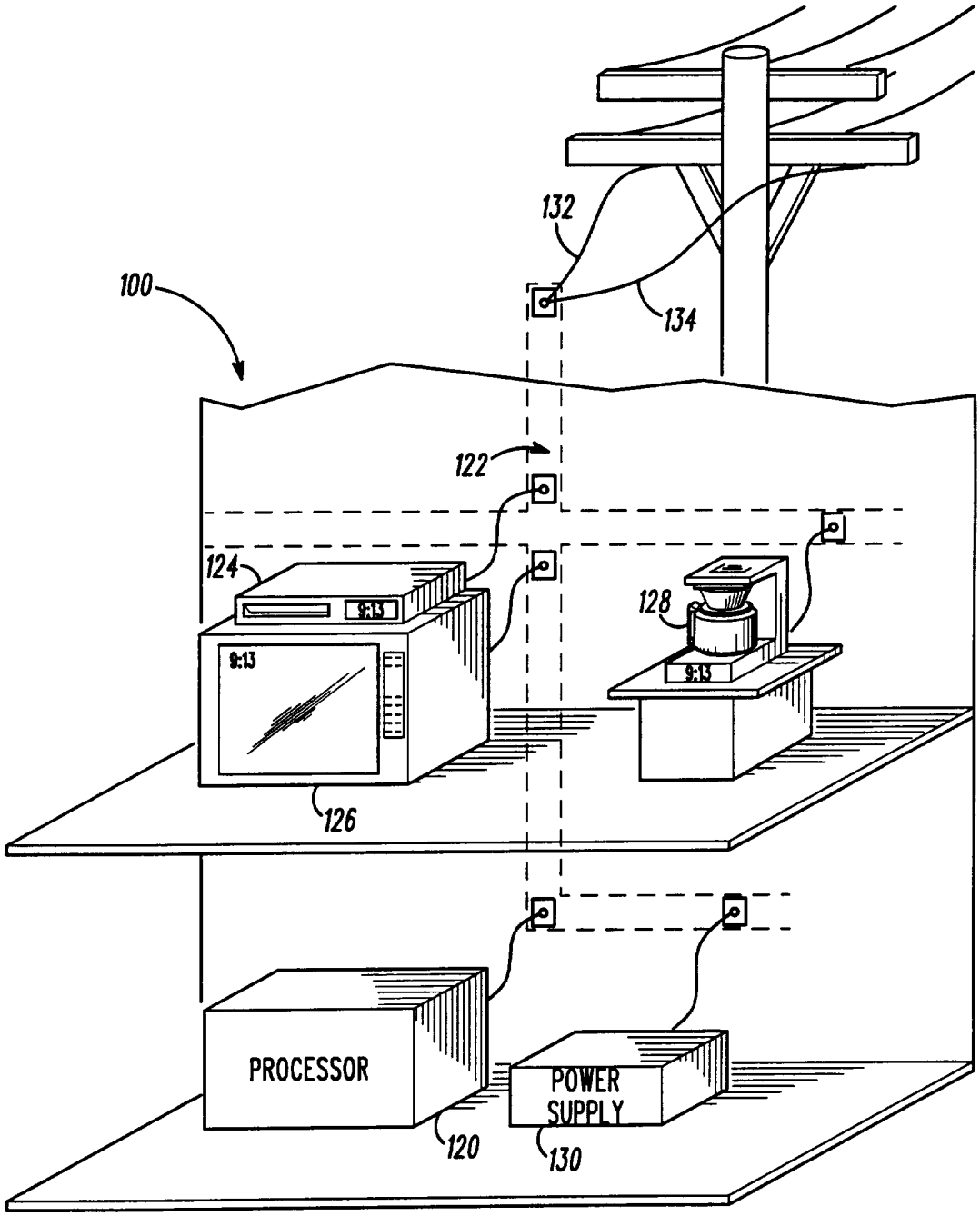

100
132
134
122
124
9:13
9:13
128
9:13
126
PROCESSOR
POWER SUPPLY
120
130

FIG.3

FIG.4

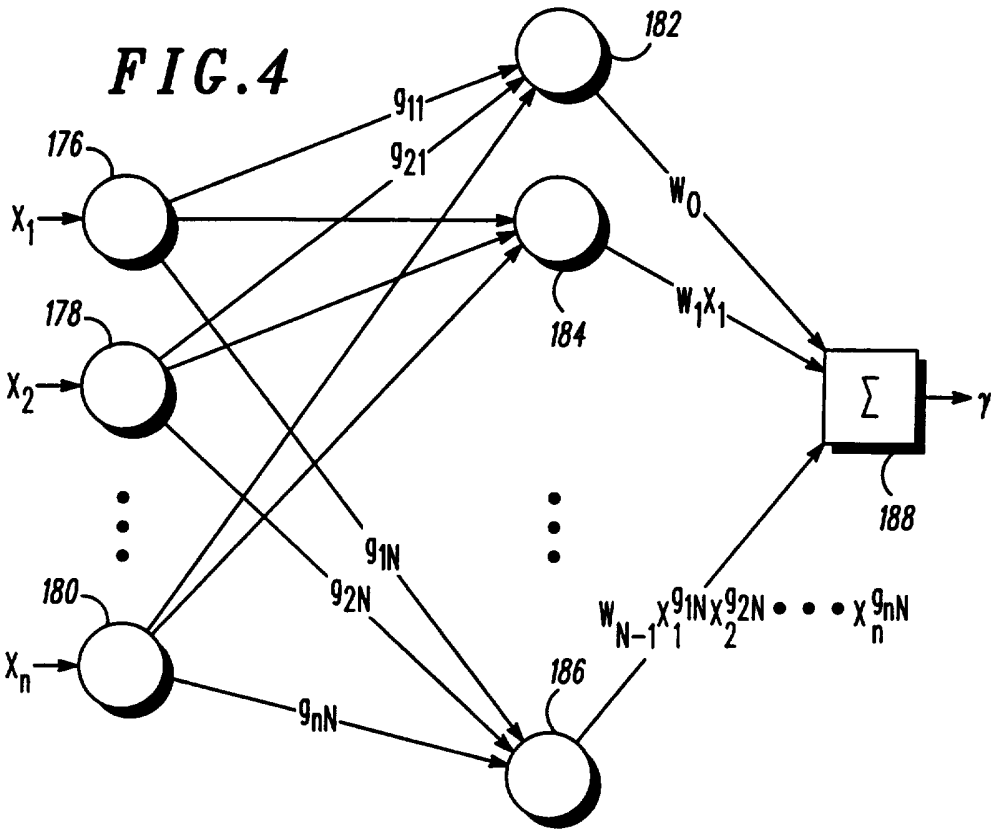

182
176
178
180
184
186
188
X_1
X_2
X_n
g_{11}
g_{21}
g_{1N}
g_{2N}
g_{nN}
W_0
W_1X_1
$W_{N-1}X_1^{g_{1N}}X_2^{g_{2N}}\cdots X_n^{g_{nN}}$
Σ
Y

FIG.5

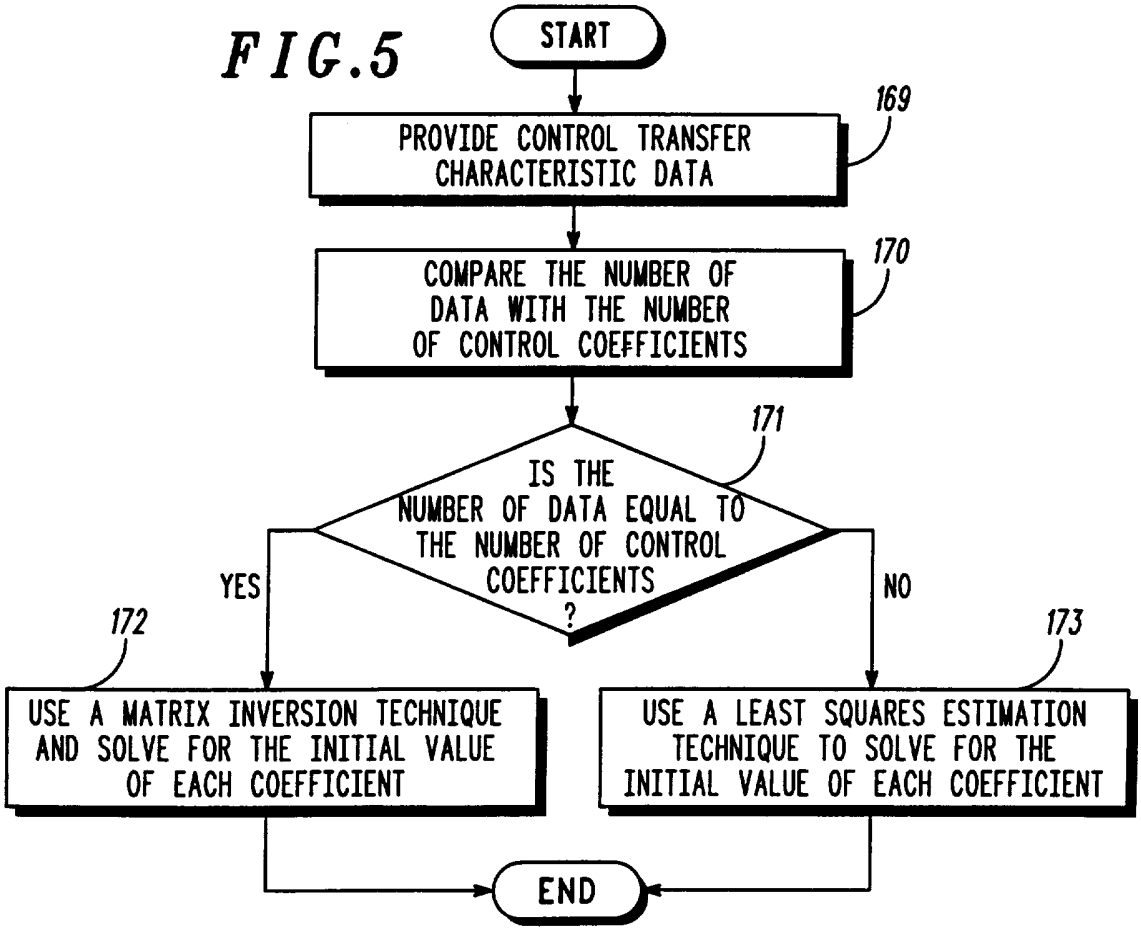

START
PROVIDE CONTROL TRANSFER CHARACTERISTIC DATA
169
COMPARE THE NUMBER OF DATA WITH THE NUMBER OF CONTROL COEFFICIENTS
170
171
IS THE NUMBER OF DATA EQUAL TO THE NUMBER OF CONTROL COEFFICIENTS ?
YES
NO
172
USE A MATRIX INVERSION TECHNIQUE AND SOLVE FOR THE INITIAL VALUE OF EACH COEFFICIENT
173
USE A LEAST SQUARES ESTIMATION TECHNIQUE TO SOLVE FOR THE INITIAL VALUE OF EACH COEFFICIENT
END

FIG.6

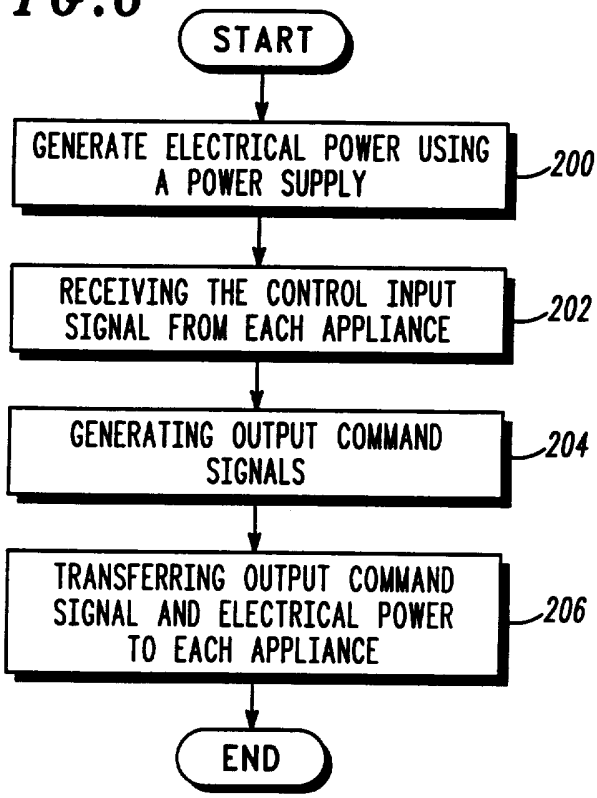
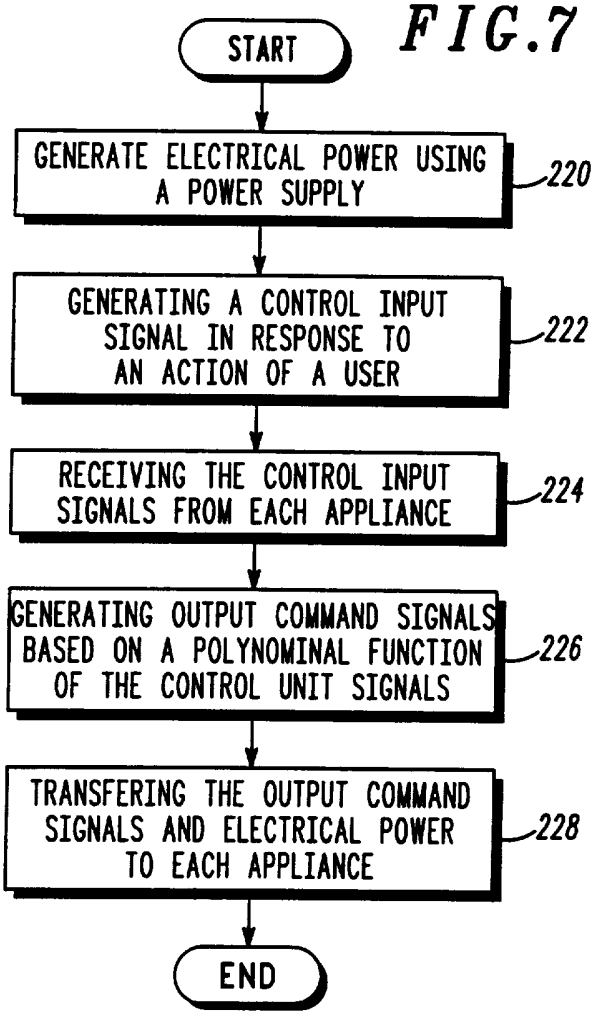

START
GENERATE ELECTRICAL POWER USING A POWER SUPPLY
200
RECEIVING THE CONTROL INPUT SIGNAL FROM EACH APPLIANCE
202
GENERATING OUTPUT COMMAND SIGNALS
204
TRANSFERRING OUTPUT COMMAND SIGNAL AND ELECTRICAL POWER TO EACH APPLIANCE
206
END

FIG.7


START
GENERATE ELECTRICAL POWER USING A POWER SUPPLY
220
GENERATING A CONTROL INPUT SIGNAL IN RESPONSE TO AN ACTION OF A USER
222
RECEIVING THE CONTROL INPUT SIGNALS FROM EACH APPLIANCE
224
GENERATING OUTPUT COMMAND SIGNALS BASED ON A POLYNOMINAL FUNCTION OF THE CONTROL UNIT SIGNALS
226
TRANSFERING THE OUTPUT COMMAND SIGNALS AND ELECTRICAL POWER TO EACH APPLIANCE
228
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/11373

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G05B 19/042
US CL :364/492A

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)

U.S. : 364/492A, 550, 551.01, 132, 138, 139, 140, 141, 146; 307/31, 39, 40; 340/825.06, 310.01

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

NON-PATENT LITERATURE

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

PROQUEST, APS, DIALOG

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EDN-Tahcnology Feature, 20 JULY 1992, Maury Wright, "Low-cost control LANs add automation to homes, autos, and offices," pp. 182-188.	1-10
A	JEI - Journal of the Electronics Industry, Vol. 31, No. 3, MARCH 1984, "Centralizing security, communication and control brings home control closer to reality," pp. 18-24.	1-10
Y	Popular Science, JUNE 1990, V. E. Gilmore, "The integrated automated educated house," pp. 104-107, especially p. 106, col. 1, paragraph 4.	5, 6
A	Machine Design, Vol. 55, No. 24, 20 OCTOBER 1983, F.W. Gutzwiller, "Control networks for the home," pp. 109-12.	1-10

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"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
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"E"	earlier document published on or after the international filing date	"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
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Date of the actual completion of the international search
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International application No.
PCT/US95/11373

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	US, A, 5,410,292, (LE VAN SUU) 25 APRIL 1995, Fig. 1, Fig. 3, col. 3, ln. 57-col. 6, ln. 44.	1-10
X -- Y	US, A, 4,174,517 (MANDEL) 13 NOVEMBER 1979, Figs. 1-3, col. 2, ln. 5-46.	1-5, 10 ---------- 6
X -- Y	US, A, 5,109,222 (WELTY) 28 APRIL 1992, Fig. 5, col. 3, ln.1-60.	1-5, 10 ---------- 6
X -- Y	US, A, 4,418,333 (SCHWARZBACH ET AL) 29 NOVEMBER 1983, Fig. 1, col. 2, ln. 44-66.	1-4, 10 ---------- 5, 6
X -- Y	US, A, 4,200,862 (CAMPBELL ET AL) 29 APRIL 1980, Fig. 1, col. ln, 30-col. 2, ln. 3.	1-4, 10 ---------- 5, 6
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X -- Y	US, A, 5,097,249 (YAMAMOTO) 17 MARCH 1992 Fig. 1, 6, 9, col. 3, ln. 19-col. 4, ln. 5, col. 5, ln. 48 - col. 6, ln. 12.	1-4, 10 ---------- 5, 6
X -- Y	US, A, 5,289,365 (CALDWELL ET AL) 22 FEBRUARY 1994, col. 1, ln. 57- col. 2, ln. 40.	1-4, 10 ---------- 5, 6
X -- Y	US, A, 5,321,846 (YOKOTA ET AL) 14 JUNE 1994, Figs. 1, 2, col. 2, ln. 19-34.	1-4, 6, 10 ---------- 5
X -- Y	US, A, 5,323,307 (WOLF ET AL) 21 JUNE 1994, col. 3, ln. 25-40.	1-5, 10 ---------- 6
X -- Y	US, A, 5,218,552 (STIRK ET AL) 08 JUNE 1993, Fig. 1, col. 1, ln. 58 - col. 2, ln. 13.	1-5, 10 ---------- 6