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[54] **SYSTEM AND METHOD FOR USING A SCRIPTING LANGUAGE TO SET DIGITAL CAMERA DEVICE FEATURES**

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[51] **Int. Cl.**[7] **H04N 5/76**; H04N 7/00; H04N 11/00; G06F 9/45

[52] **U.S. Cl.** **348/231**; 348/552; 395/705

[58] **Field of Search** 348/231, 233, 348/552, 232; 396/48, 429, 300; 395/705

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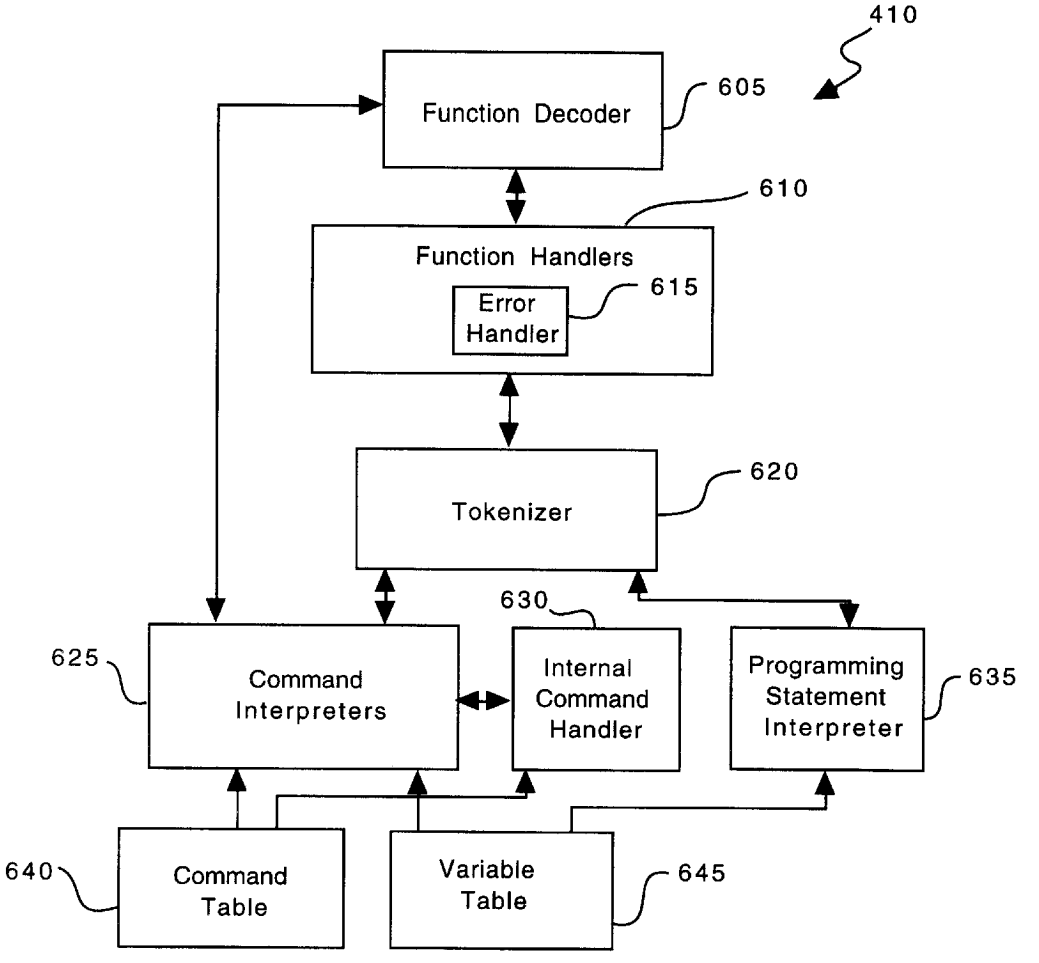
[57] **ABSTRACT**

A system and method for using scripts and selectable feature parameters to configure digital camera device features. The digital camera includes memory storing scripts for providing digital camera device features, an interface enabling a user to modify feature settings, a port connectable to a host computer for modifying or adding scripts to the memory, and a script manager for interpreting the scripts and the feature settings. The digital camera further includes an imaging device for generating a digitized image, and image processors for enhancing the digitized image according to the scripts and the selected feature settings. The digital camera still further includes command handlers for configuring the imaging device and the image processors according to the scripts and the feature settings.

12 Claims, 12 Drawing Sheets



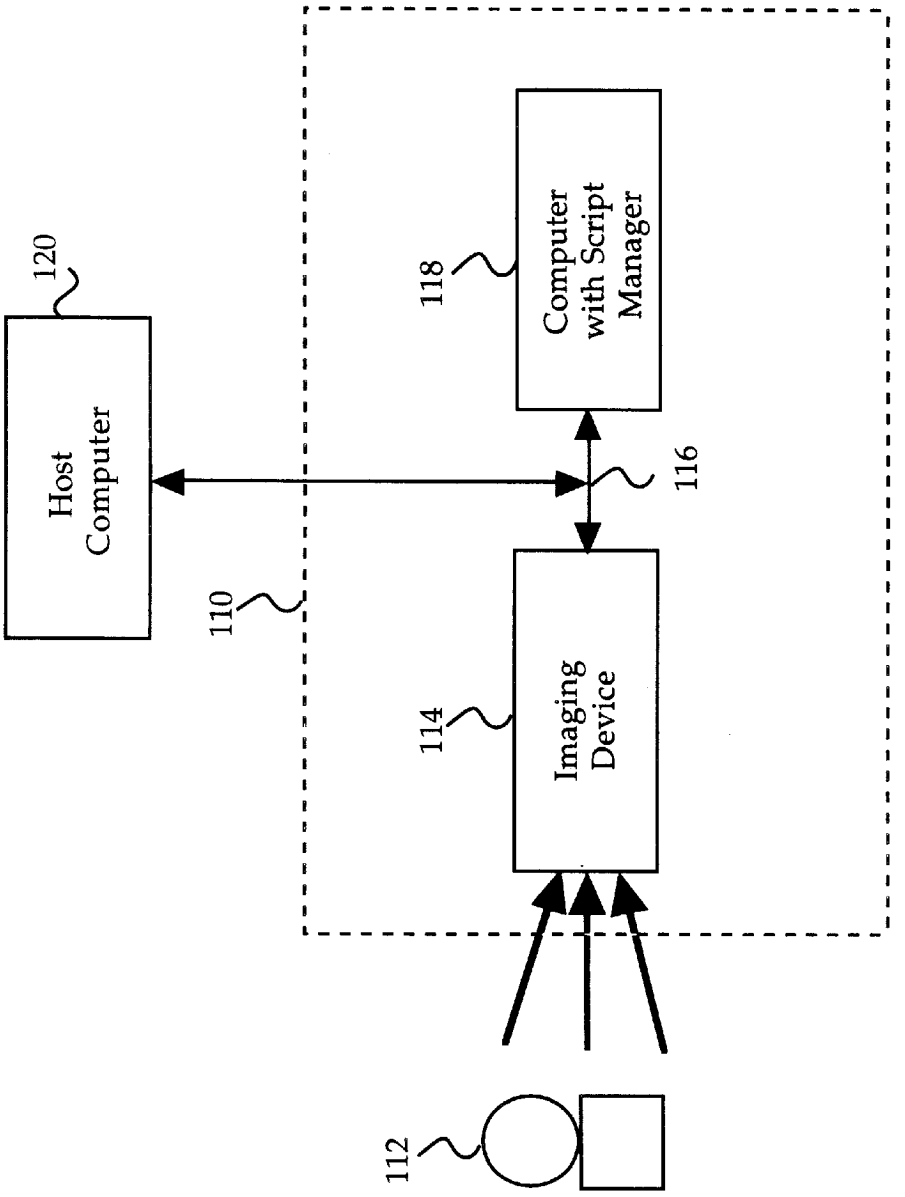

120
Host Computer
110
118
Computer with Script Manager
116
114
Imaging Device
112

Fig. 1

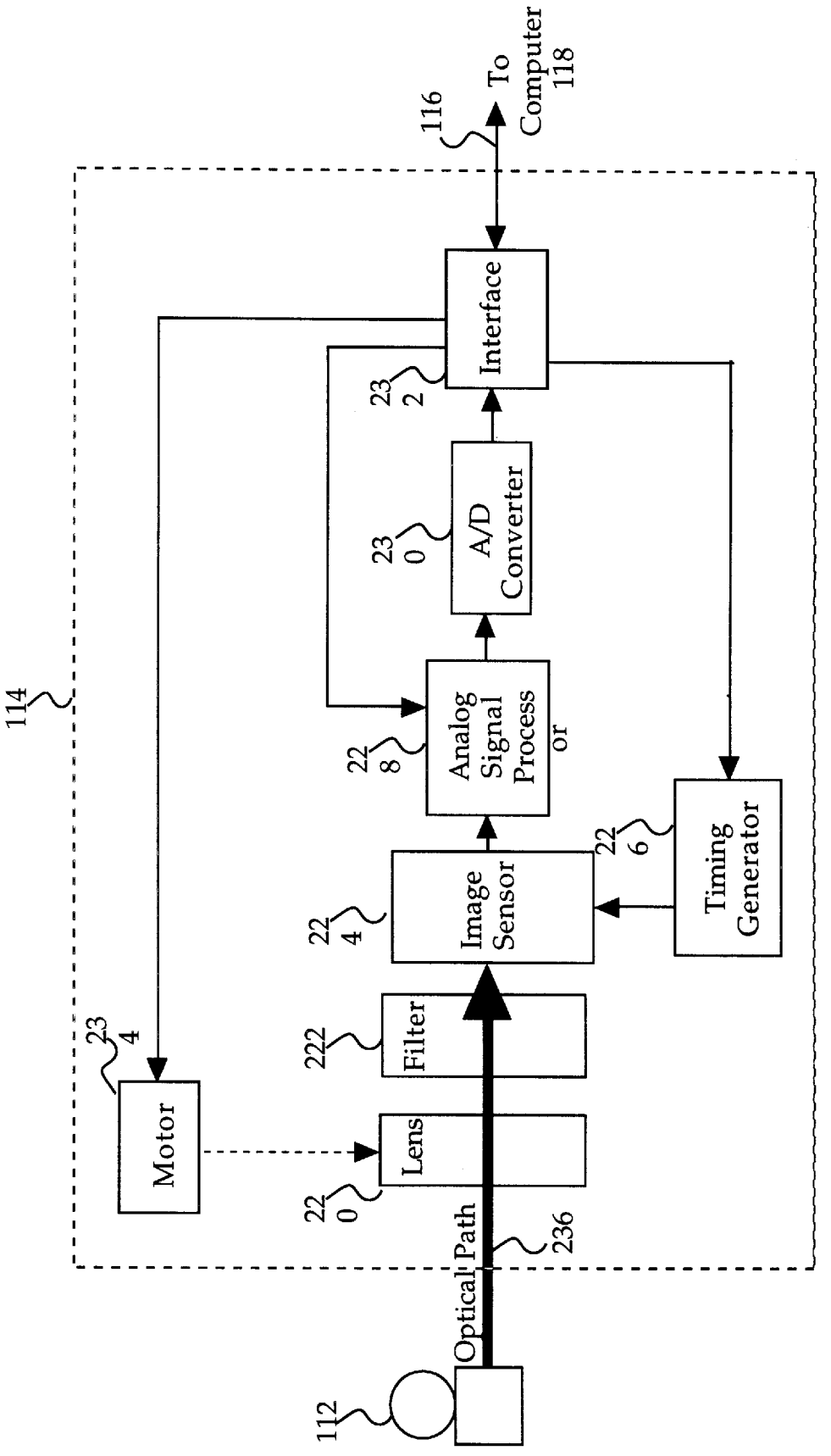

To Computer 118
116
Interface
232
A/D Converter
230
Analog Signal Processor
228
Image Sensor
224
Timing Generator
226
Filter
222
Lens
220
Motor
234
Optical Path
236
112
114

Fig. 2

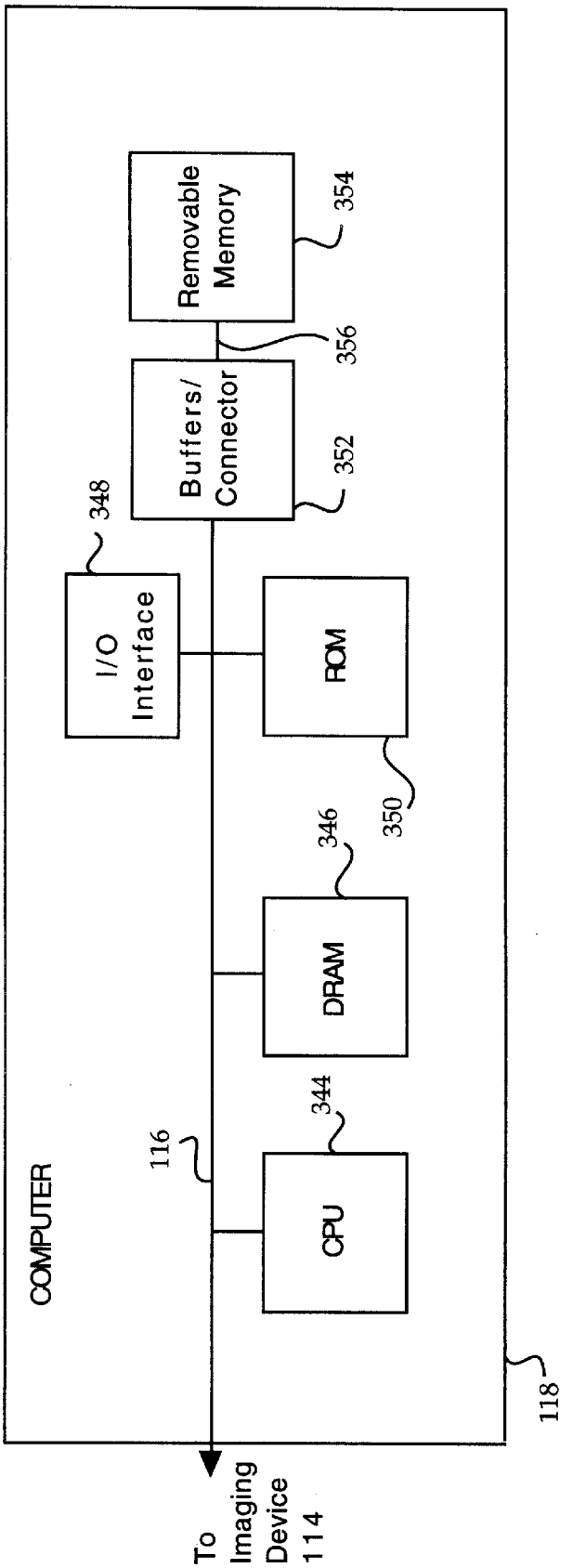

COMPUTER
116
CPU
344
DRAM
346
ROM
350
I/O Interface
348
Buffers/ Connector
352
356
Removable Memory
354
118
To Imaging Device 114

FIG. 3

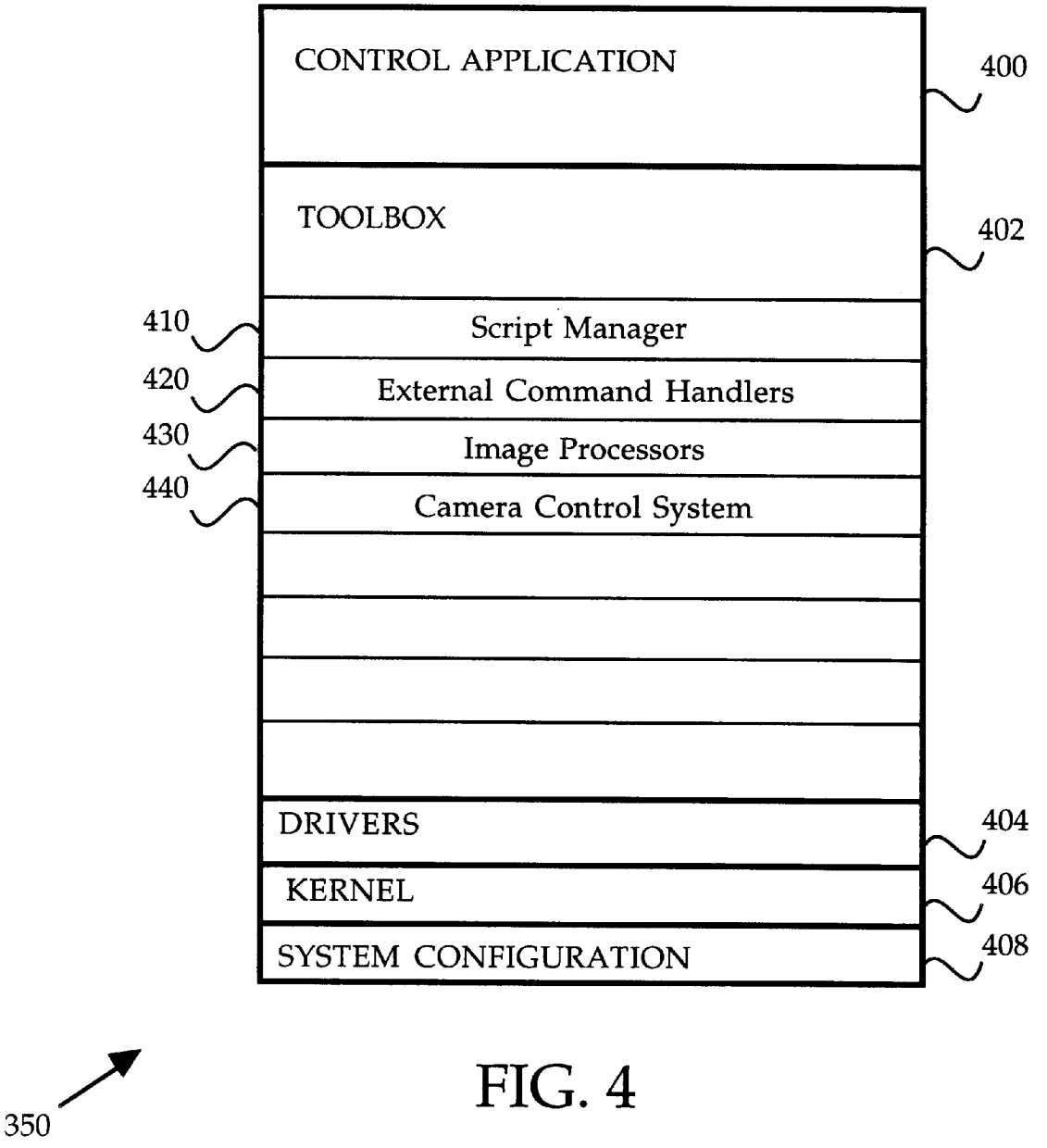

CONTROL APPLICATION
400
TOOLBOX
402
410
Script Manager
420
External Command Handlers
430
Image Processors
440
Camera Control System
DRIVERS
404
KERNEL
406
SYSTEM CONFIGURATION
408
350

FIG. 4

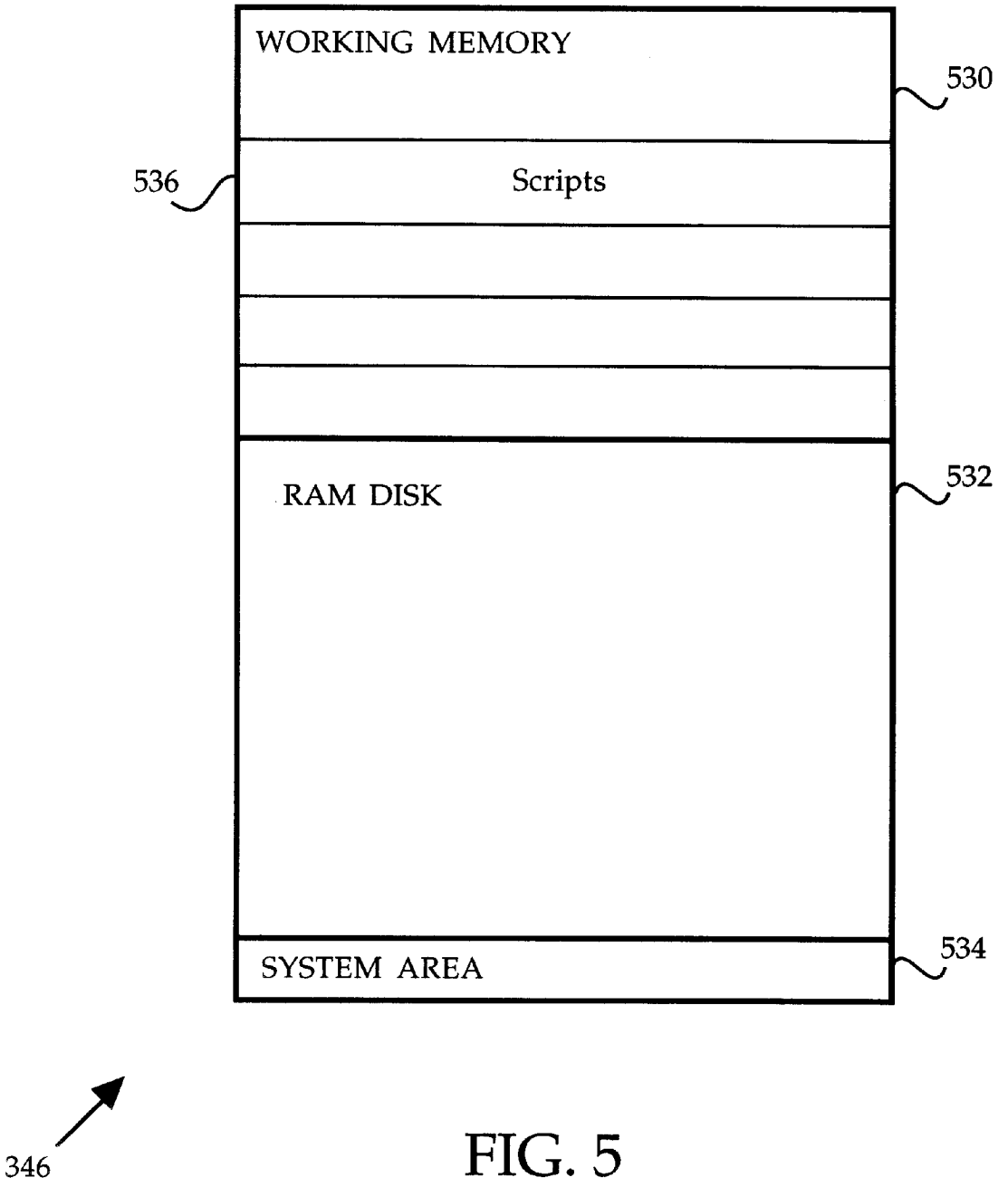

WORKING MEMORY
530
536
Scripts
RAM DISK
532
SYSTEM AREA
534
346

FIG. 5

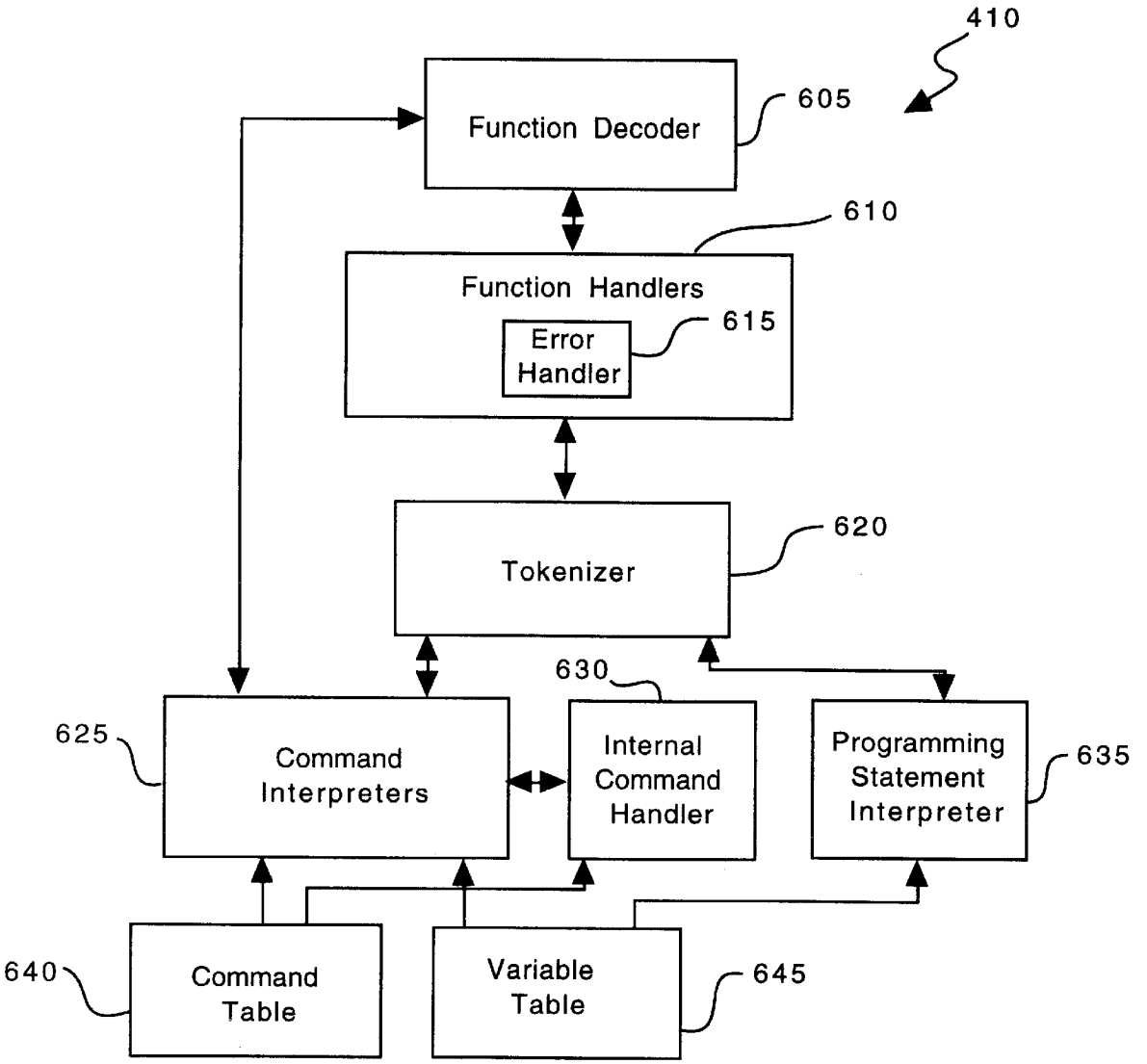

410
Function Decoder
605
610
Function Handlers
Error Handler
615
620
Tokenizer
630
625
Command Interpreters
Internal Command Handler
Programming Statement Interpreter
635
640
Command Table
Variable Table
645

FIG. 6A

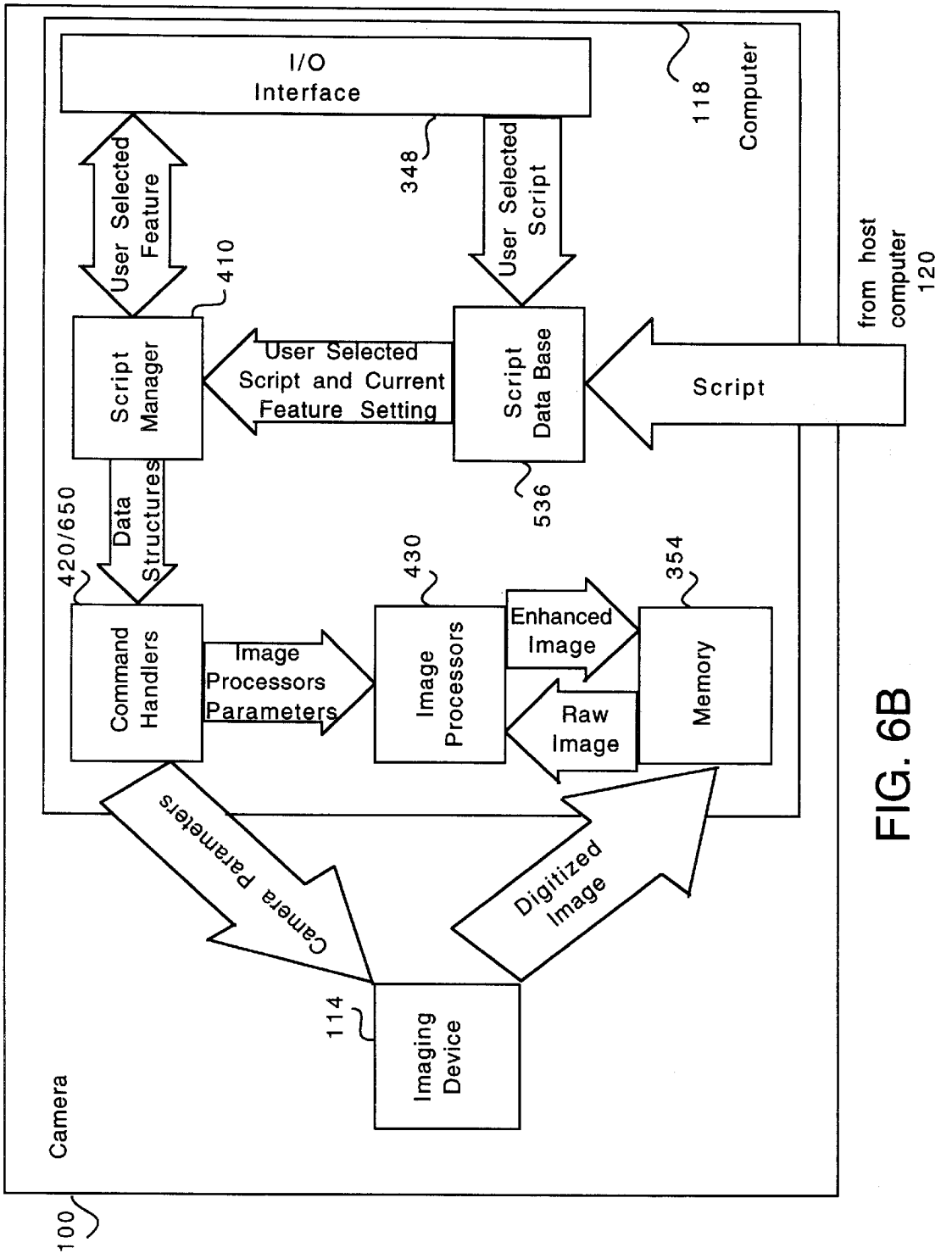
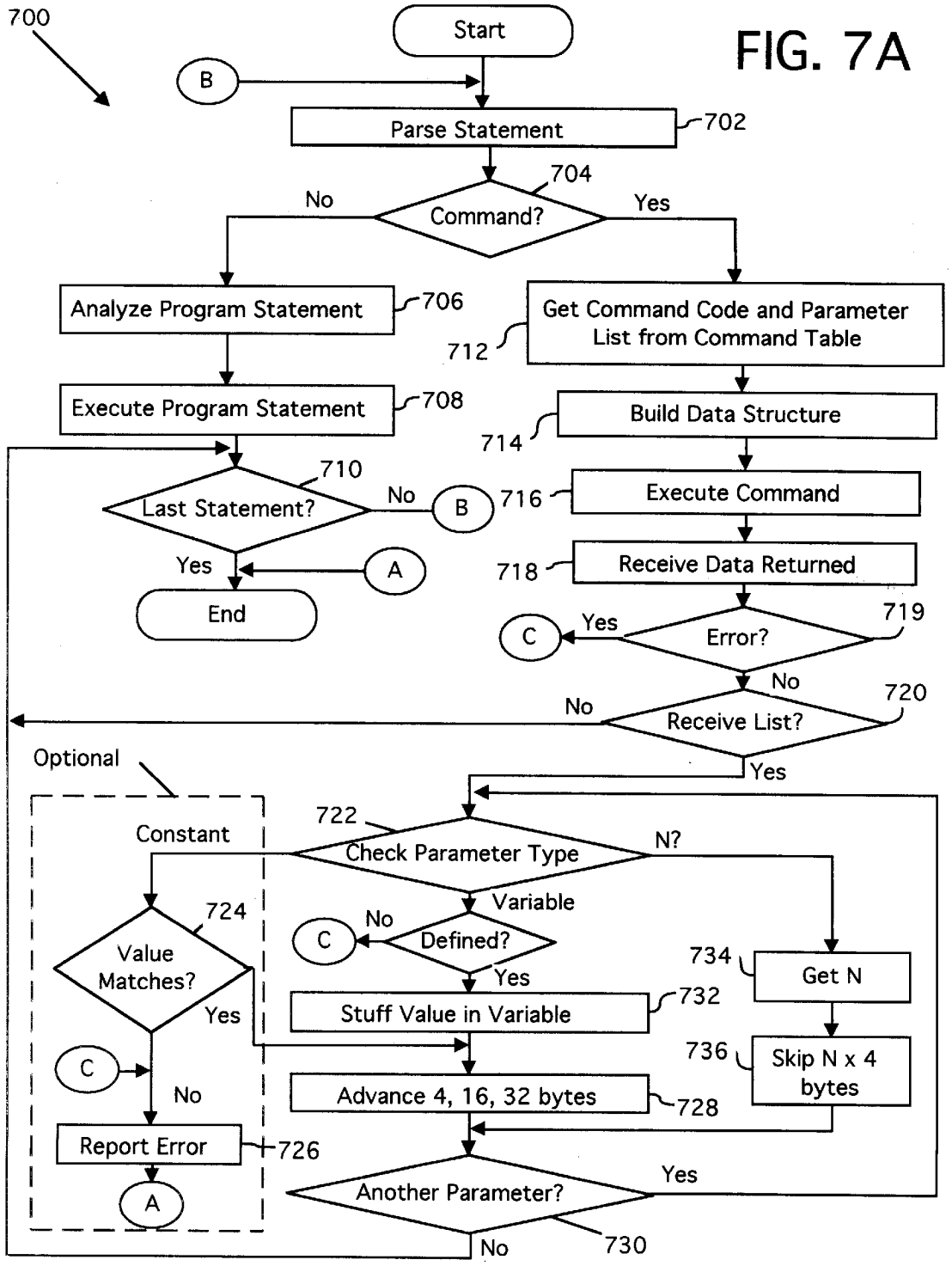

I/O Interface
348
User Selected Feature
User Selected Script
118
Computer
410
Script Manager
User Selected Script and Current Feature Setting
Script Data Base
Script
from host computer 120
536
420/650
Data Structures
430
354
Command Handlers
Image Processors Parameters
Image Processors
Enhanced Image
Raw Image
Memory
Camera Parameters
Digitized Image
114
Imaging Device
Camera
100

FIG. 6B

FIG. 7A


700
Start
B
Parse Statement
702
704
Command?
No
Yes
Analyze Program Statement
706
Execute Program Statement
708
Get Command Code and Parameter List from Command Table
712
Build Data Structure
714
Execute Command
716
Receive Data Returned
718
Error?
719
Yes
C
No
Receive List?
720
No
Yes
Last Statement?
710
No
B
Yes
A
End
Optional
Constant
722
Check Parameter Type
N?
Variable
724
Value Matches?
Yes
No
C
Report Error
726
A
Defined?
No
C
Yes
Stuff Value in Variable
732
Advance 4, 16, 32 bytes
728
734
Get N
736
Skip N x 4 bytes
Another Parameter?
Yes
No
730

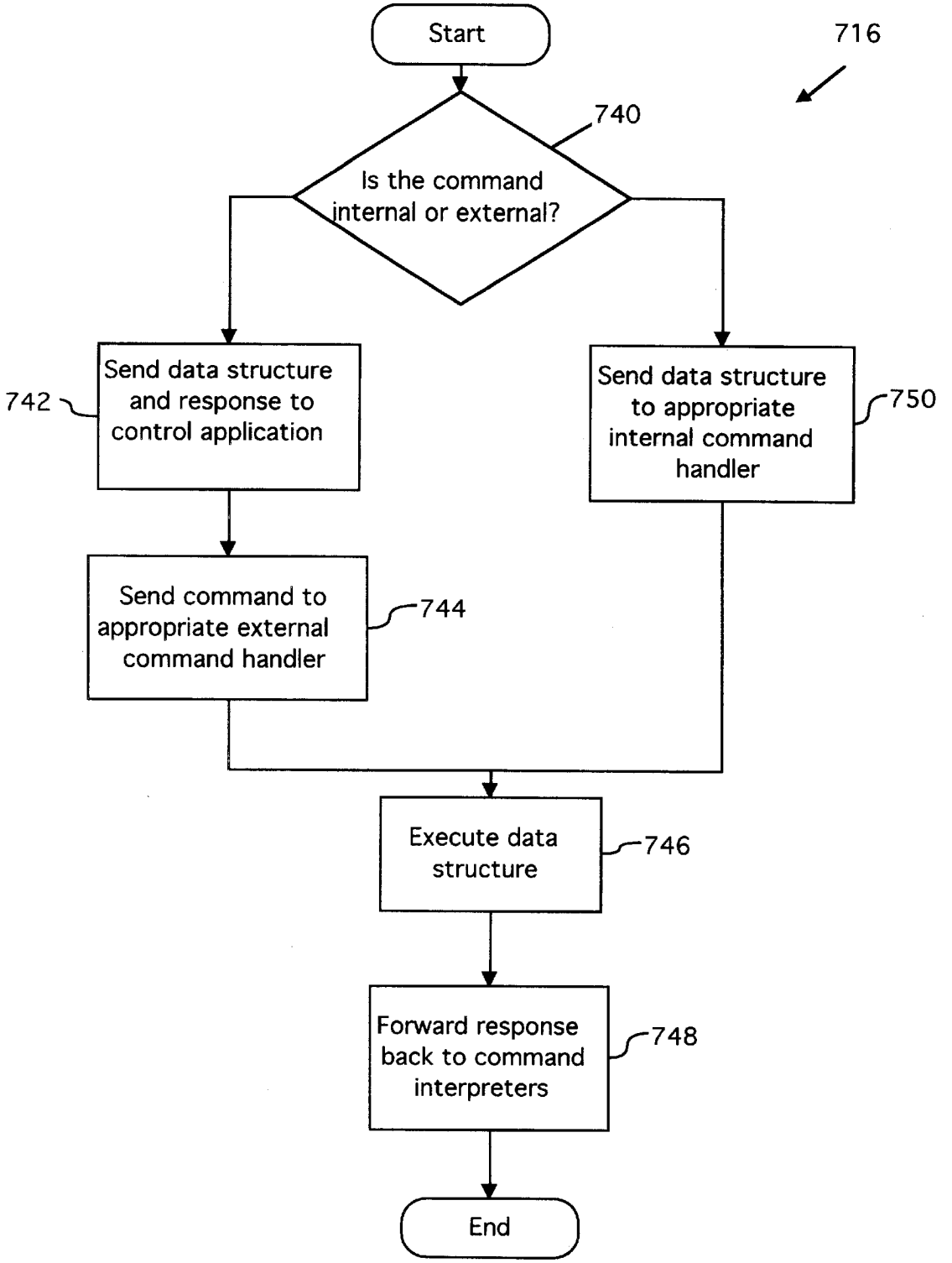

Start
716
740
Is the command internal or external?
Send data structure and response to control application
742
Send data structure to appropriate internal command handler
750
Send command to appropriate external command handler
744
Execute data structure
746
Forward response back to command interpreters
748
End

FIG. 7B

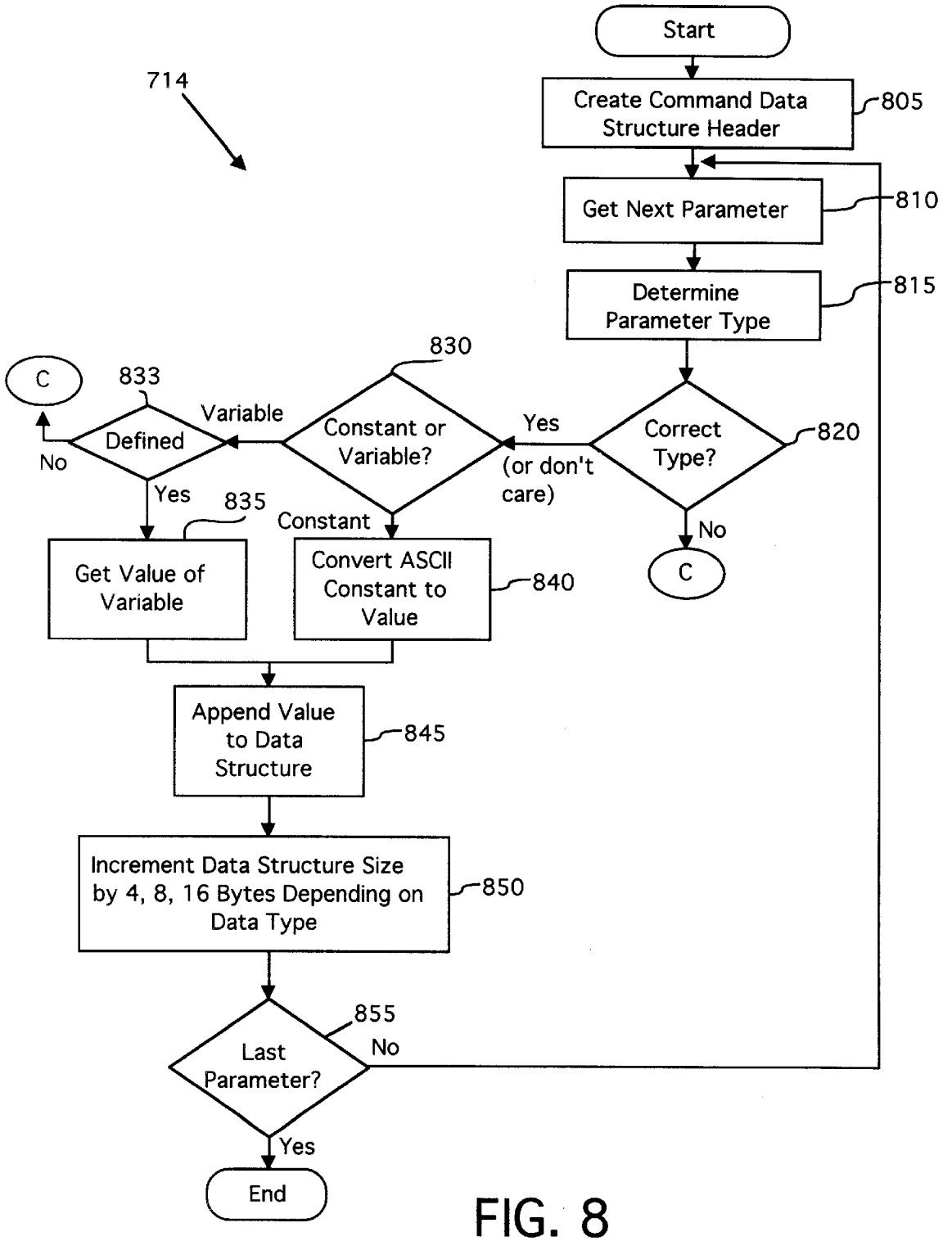
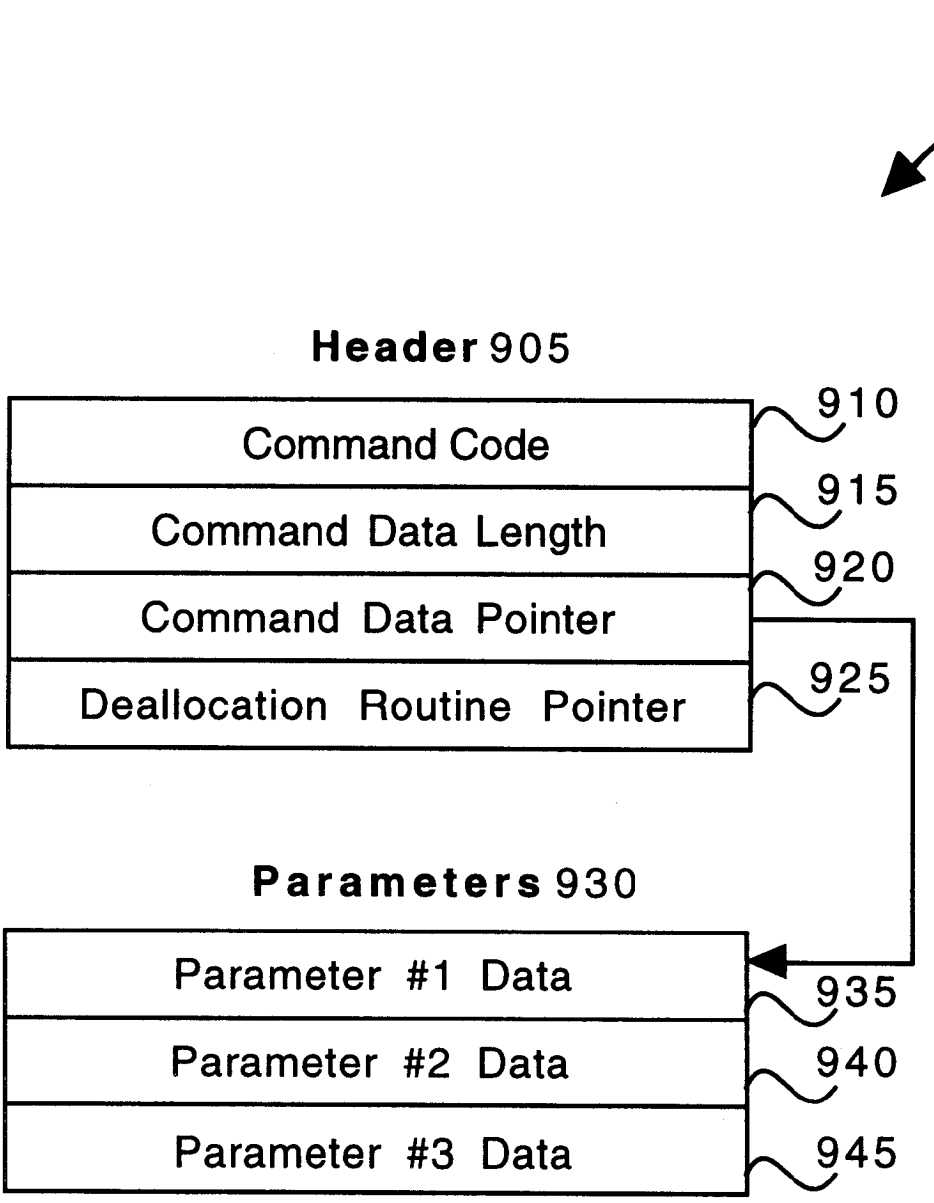
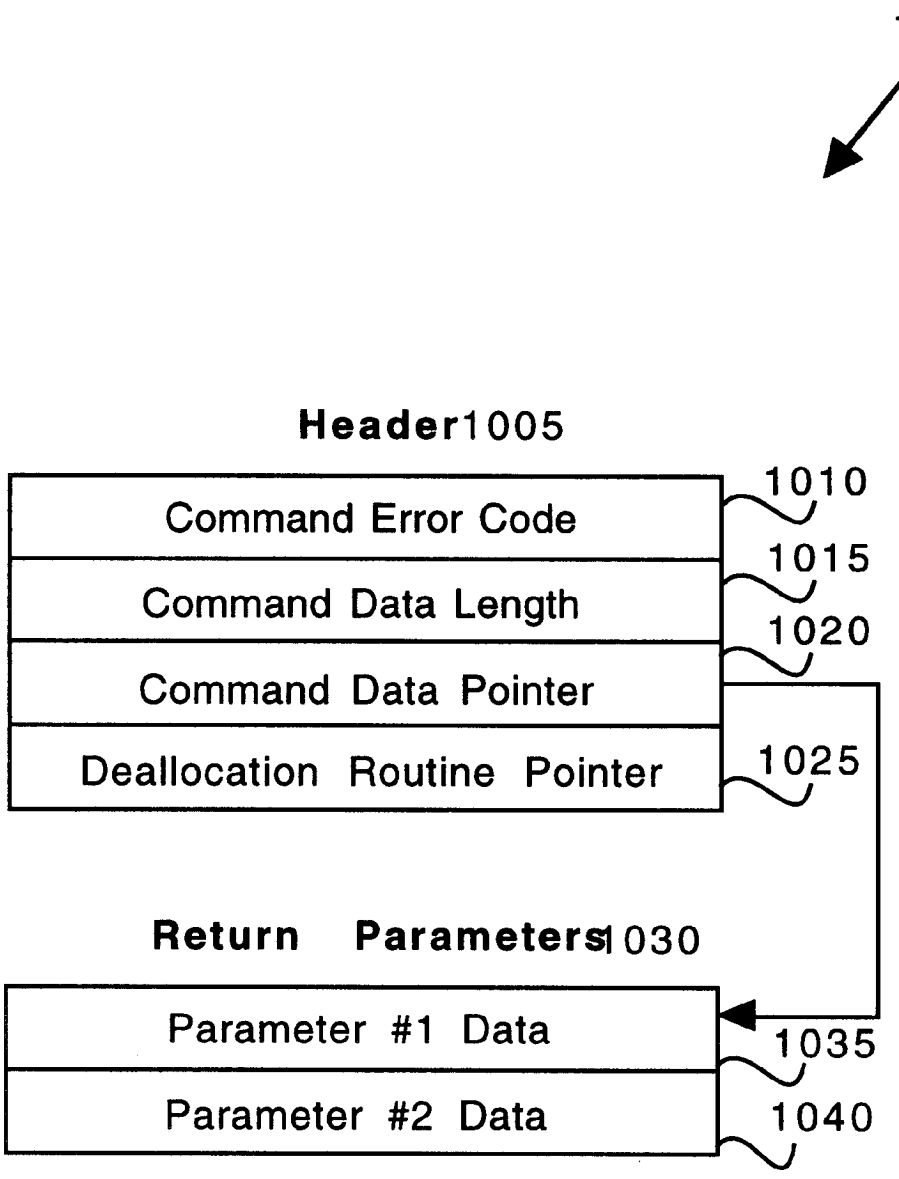

714
Start
Create Command Data Structure Header
805
Get Next Parameter
810
Determine Parameter Type
815
Correct Type?
820
Yes
(or don't care)
No
C
Constant or Variable?
830
Constant
Variable
Convert ASCII Constant to Value
840
Defined
833
C
No
Yes
Get Value of Variable
835
Append Value to Data Structure
845
Increment Data Structure Size by 4, 8, 16 Bytes Depending on Data Type
850
Last Parameter?
855
No
Yes
End

FIG. 8



(Command Send Data Structure)

FIG. 9



(Command Receive Data Structure)

FIG. 10

SYSTEM AND METHOD FOR USING A SCRIPTING LANGUAGE TO SET DIGITAL CAMERA DEVICE FEATURES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application relates to co-pending U.S. patent application Ser. No. 08/631,173, entitled "System and Method for Using a Unified Memory Architecture to Implement a Digital Camera Device," which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to digital cameras and more particularly to a system and method for using a scripting language to set digital camera device features.

2. Description of the Background Art

A modern digital camera typically includes an imaging device and a built-in computer. The imaging device captures raw image information representing a scene and is controlled by the built-in computer system. The built-in computer system receives, processes and compresses the raw image information before storing the compressed digital information in an internal memory.

A typical digital camera enables a user to manipulate mechanical buttons, rotatable and toggle switches, etc. to select a few of the camera feature settings. However, the remainder of the digital camera features are typically based on built-in computer system programming. Original Equipment Manufacturers (OEMs) set the software-based features and software-based feature settings for each digital camera. Accordingly, consumers examine both the camera hardware and the camera programming to determine whether or not to purchase the camera.

Except for a few OEM selected features, the camera feature programming is stored in Read-Only Memory (ROM). Thus, the majority of the camera feature programming is not user accessible and thus not modifiable. Further, new features cannot be added. A system and method are needed for enabling an ordinary user to set digital camera device features easily. Further, a system and method are needed for enabling a programmer to add digital camera device features which are also settable by the ordinary user.

SUMMARY OF THE INVENTION

In accordance with the present invention, a system and method are disclosed for using scripts to implement digital camera features. The digital camera includes memory storing scripts for providing digital camera device features, an interface for receiving user selected feature settings, a script manager for interpreting the scripts and the feature settings to generate data structures, and a command handler for configuring the camera to provide the camera features. The digital camera further includes an imaging device for generating a digitized image and image processors for enhancing the digitized image. Since the user need only select the camera feature script and then run and optionally interact with the camera-configuring script, the ordinary user can modify the camera features.

The digital camera includes a port connectable to host computer for adding or modifying scripts to add or modify available camera features. The host computer uses a text editor application program to generate or modify scripts, and optionally uses any error detection application program for error testing the script. The camera may be connected to the host computer for downloading the newly-generated camera-configuring script into camera memory. Alternately, the script can be loaded onto a removable memory card and inserted into the camera. The added or modified script can be run to configure the camera according to a selected feature and setting.

The invention further provides a method for generating data structures from a script. The method begins by receiving a feature setting command which includes a command name, a feature name and a feature setting by an interface from a user. Using a command table which includes a set of command names and corresponding command codes, command codes are extracted based on the command names. Using a command parameter table which includes corresponding parameter formats, the parameters are extracted based on the parameter format list. Parameters may include feature names and settings. Accordingly, a data structure which includes the command code and parameters, including any feature settings in the specified format is then generated by the script manager. The data structure is sent to a command handler for execution and generation of responsive data, which is sent back to the script manager for processing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a digital camera in accordance with the present invention;

FIG. **2** is a block diagram illustrating the imaging device of FIG. **1**;

FIG. **3** is a block diagram illustrating the computer of FIG. **1**;

FIG. **4** is a memory map illustrating the ROM of FIG. **3**;

FIG. **5** is a memory map illustrating the DRAM of FIG. **3**;

FIG. **6**A is a block diagram illustrating the FIG. **4** script manager;

FIG. **6**B is a block diagram illustrating operations of the FIG. **1** camera;

FIG. **7**A is a flowchart illustrating the preferred method for generating a data structure from a script statement;

FIG. **7**B is a flowchart illustrating the preferred method for executing a command;

FIG. **8** is a flowchart further illustrating the step of building a data structure of FIG. **7**A;

FIG. **9** is a block diagram illustrating an external command send data structure; and

FIG. **10** is a block diagram illustrating an external command receive data structure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a block diagram of a digital camera **110** having modifiable camera features such as exposure, focus, date/time stamp, etc., and coupled to a host computer **120**. Camera **110** comprises an imaging device **114** coupled via a system bus **116** to a computer **118**. When a photographer depresses an action button (not shown), computer **118** instructs imaging device **114** to take a picture of an object **112**. Imaging device **114** optically captures and forwards light-based image information representing object **112** via system bus **116** to computer **118**. Based on the camera **110** features, computer **118** performs various image processing functions on the image information before storing the processed data in internal memory (not shown).

Camera **110** uses scripts, which may be authored and error tested on host computer **120**, to configure its features. A conventional text editor application program (not shown) may be used on host computer **120** for generating a script and an error reporter application program (not shown) may be used on host computer **120** for error testing the script. If the error reporter locates an error, then the script may be edited until the error reporter determines that the script will provide the intended camera **110** feature. Camera **110** may be connected to host computer **120**, and the script may be downloaded from host computer **120** into camera **110** by moving the script to a system folder (not shown) in camera **110** memory or to a flash disk.

FIG. **2** is a block diagram illustrating imaging device **114**, which comprises a lens **220**, a filter **222**, an image sensor **224**, a timing generator **226**, an analog signal processor **228**, an analog-to-digital (A/D) converter **230**, an interface **232** and a motor **234**. A detailed discussion of the preferred elements of imaging device **114** is provided in U.S. patent application Ser. No. 08/355,031, entitled "A System and Method For Generating a Contrast Overlay as a Focus Assist for an Imaging Device," filed on Dec. 13, 1994, which is hereby incorporated by reference.

Briefly, light-based information identifying object **112** passes along optical path **236** through lens **220** and filter **222** to image sensor **224**. Image sensor **224** captures the light data, generates light-based image information from the light data, and routes the light-based image information through analog signal processor **228**, AID converter **230** and interface **232**. Interface **232** controls analog signal processor **228**, motor **234** and timing generator **226**, and passes the light-based image information via system bus **116** to computer **118**.

FIG. **3** is a block diagram illustrating computer **118**, which comprises a central processing unit (CPU) **344**, Dynamic Random-Access Memory (DRAM) **346**, an Input/Output (I/O) interface **348** and Read-Only Memory (ROM) **350**, each connected to system bus **116**. Computer **118** optionally further includes a buffers/connector **352** coupled to system bus **116**, and a removable memory **354** coupled via a path **356** to buffers/connector **352**.

CPU **344** controls camera **110** operations and may include a microprocessor device such as Motorola MPC821 manufactured by Motorola, Inc. of Schaumburg, Ill. or a Hitachi SH3 manufactured by Hitachi America, Ltd. of Terrytown, N.Y. CPU **344** optionally uses a multithreaded environment for concurrent activation of multiple camera **110** control functions. DRAM **346** is conventional DRAM selectively allocated to various storage functions including image data storage. I/O interface **348** permits host computer **120** or a user via externally-mounted user controls and an external LCD display panel to communicate with computer **118**.

ROM **350** stores computer-readable program instructions for controlling camera **110** operations. Buffers/connector **352** provides an interface, such as a Personal Computer Memory Card International Standard (PCMCIA) slot, for connecting a removable memory. Removable memory **354** is preferably a readily removable and replaceable non-volatile data storage device such as a flash disk, and serves as an additional image data storage area. A user who possesses several removable memories **354** may replace a full removable memory **354** with an empty removable memory **354** to effectively expand the picture-taking capacity of camera **110**.

FIG. **4** is a memory map illustrating ROM **350**, which stores programs including a control application **400**, a toolbox **402**, drivers **404**, a kernel **406** and a system configuration **408**. Control application **400** comprises program instructions for managing the various camera **110** functions and executing script commands. Toolbox **402** comprises selected function modules including a script manager **410**, external command handlers **420**, image processors **430** and camera control system **440**. Script manager **410** operates as a script interpreter by generating data structures from script statements which are used to provide the camera **110** features. External command handlers **420** manage the data structures generated by script manager **410** and may store parameter values in a programmable RAM (PRAM) such as an EEPROM. Image processors **430** are programs for enhancing (e.g., adjusting the contrast, sharpening, converting the image to gray-scale, etc.) the digital image received from imaging device **114**. Camera control system **440** receives and processes the data structures from the external command handlers **420** for controlling camera functions. System functions, I/O functions, camera hardware functions, image processor functions are controlled by the control application and toolbox routines receiving data structures from external command handlers. Script manager **410** operations are described in greater detail with reference to FIG. **6**.

Drivers **404** comprise program instructions for controlling various camera **110** hardware components, such as motor **234** (FIG. **2**) and a flash (not shown). Kernel **406** comprises program instructions providing basic underlying camera **110** services including synchronization routines, task creation, activation and deactivation routines, resource management routines, etc. System configuration **408** comprises program instructions for providing initial camera **110** start-up routines such as the system boot routine and system diagnostics.

FIG. **5** is a memory map illustrating DRAM **346**, which includes a working memory **530**, a RAM disk **532** and a system area **534**. Working memory **530** stores camera-configuring scripts **536**. Scripts **536** comprise program statements which may include commands, which are loaded at start-up by the configuration software from the RAM disk or flash disk. A command is a function routine call comprising a command name, optionally a send list and optionally a receive list. An example of a command is "GetCameraStates (1,'hint':3?,hint)" where "GetCameraStates" is the command name, "1,'hint'" is the send list, ":" separates the send list from the receive list, and "3?,hint" is the receive list. The command name GetCameraStates calls the function routine for retrieving the status value of a particular feature. The "1" in the send list indicates that only one request is being made. The "'hint'" indicates that the value requested is for the hint feature. The "3?" in the receive list indicates that upon receipt of responsive data three values should be skipped, and the "hint" in the receive list specifies the variable in which to store the fourth value. Combining both the send list and the receive list in the command provides a simple command structure.

A script for configuring the camera hint mode, which enables the camera to select exposure type automatically (AUTO), to set exposure such that the background is out of focus (PORT), to set the exposure to capture as much depth of field as possible (LAND), to shift exposure to provide a fast shutter speed for moving objects (SPRT) or to maximize depth of field for objects in very close proximity (CLOS), is as follows:

```
#HINT_01.CSM                                    (1)
name "Set Exposure Hint Mode"                   (2)
declare u:hint                                  (3)
GetCameraStates(1,"hint":3?,hint)               (4)
get hint                                        (5)
  1: "AUTO"
  2: "PORT"
  3: "LAND"
  4: "SPRT"
  5: "CLOS"
end                                             (6)
SetCameraStates(false,1,"hint",hint)            (7)
SetScriptStatus(1,"hint")                       (8)
```

Script manager **410** enables execution and re-execution of the script for modifying and re-modifying the hint mode setting. At any time, a user can instruct script manager **410** to execute the exposure hint feature script for setting or resetting the hint feature.

Statement (1) is a comment identifying the DOS name of the script. Statement (2) specifies the script description to be provided upon user request. Statement (3) defines a variable "hint" as an unsigned integer u. A variable type table is shown below in table 1.

TABLE 1

Variable Types

Specifier	Description
u	32 bits unsigned integer.
i	32 bits signed integer.
f	32 bits signed fractional part in signed 15 bits signed integer and 16 bits fraction.
s	32 bytes characters containing a string up to 31 significant characters terminated by a null character.
n	16 bytes string contains DOS filename, format as (8 characters).(3 characters) or (8 characters).
p	4 characters string.
b	32 bits of Boolean flags, each bit can be either true(1) or false(0).
l	identifier used to indicate a label name.

Statement (4) is a command for retrieving the previously set value of hint. Statement (5) is a user interaction statement which comprises a command requesting that the user accept or modify the hint mode setting. The list of values and strings separated by colons is the feature value related to the string name for that feature. The user selects a feature by name, and the selected name's value is returned in the variable. Statement (6) ends the list in statement (5). Statement (7) instructs control application **400** to reconfigure the hint mode as the user selects. Lastly, statement (8) communicates modifications to the user via the optional LCD status display.

RAM disk **532** is a RAM-based data storage area for storing the compressed light-based image information and is typically organized in a sectored format similar to that of conventional hard disk drives. RAM disk **532** may use a standardized file system enabling the external host computer system (not shown) to readily access stored data. Because the information is actually stored in RAM, the data can be easily and quickly retrieved. System area **534** typically stores system error information for CPU **344** to report upon restarting computer **118** after a system error occurs.

FIG. **6**A is a block diagram illustrating script manager **410** which includes a function decoder **605**, function handlers **610**, a tokenizer **620**, a command interpreter **625**, internal command handlers **630**, a programming statement interpreter **635**, a command table **640** and a variable table **645**.

Function decoder **605** is a program routine for managing and decoding script messages received from control application **400**. Function decoder **605** forwards the decoded script messages to function handlers **610**, which are program routines for managing these messages. If the script message only includes simple instructions (i.e., instruction such as initialize, abort, search for, GetName and Reset which do not require script execution), then function handlers **610** perform the required functions and return the appropriate responses via function decoder **605** back to control application **400**. If the script message includes a complex instruction, (i.e., an instruction such as GetCameraStates or SetCameraStates which requires script execution and interpretation), then function handlers **610** forward the message to tokenizer **620** for complex instruction handling.

Tokenizer **620** examines the syntax of the statements in the script message to convert the statement's ASCII codes into tokens. Tokenizer **620** passes tokens corresponding to script commands to command interpreters **625** and tokens corresponding to Arithmetic Logic Unit (ALU) statements, Input/Output (I/O) statements, control statements and documentation statements to programming statement interpreter **635**.

Command interpreters **625** generate data structures representing the tokens. Command interpreters **625** forward the data structures for external commands (i.e., commands which are used system-wide such as GetCameraStates or SetCameraStates and which require computations or information exchange with external components) to external command handlers **420**, by passing them back as a response via the function decoder **605**. The control application then passes the response to the appropriate external command handler **420** for processing based on the command code. Command interpreters **625** pass data structures for internal script commands (i.e., commands which are dedicated to script manager **410** such as Wait, Write, GetTimeString or GetDateString) are passed to internal command handler **630**.

To indicate whether a command is an internal command or an external command, each command entry in the command table may include an external/internal flag, command interpreter **625** may include an external/internal command table, or the command values may indicate accordingly. To create a data structure from a script command, command interpreters **625** use command table **640** and variable table **645**. An example command table **640** is shown in table 2.

TABLE 2

Command Table

Command Name	Command Code	Parameter Count	Parameter Type List
"GetCameraStates"	0 × 0005	2	1, 16, 0, 0, 0, 0
"GetCameraCapabilities"	0 × 0006	2	1, 16, 0, 0, 0, 0
"SetCameraStates"	0 × 0007	3	4, 1, 17, 0, 0, 0
"GetCameraStatus"	0 × 0008	0	0, 0, 0, 0, 0, 0

The first column indicates command names, the second column indicates command codes, third column indicates the number of parameters in the parameter type send lists, and the fourth column indicates parameter type send list formats. It will be appreciated that other commands and other parameter type lists may be included in command table 2.

In conjunction with the parameter type list of command table 2, command interpreters **625** use a parameter type table 3 as follows:

TABLE 3

Parameter Type Table

Parameter	Value	Description
cuInteger	(1)	integer between 0 and 4G, 32 bit unsigned integer, a preceding 0x or 0× means hex value, otherwise decimal value.
cInteger	(2)	integer between −2G and +2G, 32 bit signed integer, a preceding 0x or 0× means hex value, otherwise decimal value.
cFixed	(3)	fixed integer between −32767.99999 . . . and +32767.99999 . . . , 32 bit signed fractional part in signed 15-bit signed integer and 16-bit fraction.
cBitFlags	(4)	Boolean and bitflags; 32 bits of Boolean flags, each bit can be either true(1) or false(0), "0b" means Boolean, "0x" or "0×" means hex, otherwise decimal value.
cPName	(6)	parameter name.
cName	(7)	DOS filename; 16 byte string surrounded by double quotes. The format is an up to 8 character filename, followed by a period, and a up to three character extension or up to 8 character filename; example "myscript.csm."
cString	(8)	a sequence of characters surrounded by double quotes, max length. is 31, no double quotes inside the character string.
cPList	(16)	parameter list.
cPVList	(17)	parameter/value list.
cNameList	(18)	DOS filename list.
cUList	(19)	unsigned integer list.

For example, the command "GetCameraCapabilities" parameter list "1,16" specifies that the send list must contain a cUInteger, which is defined as a 32 bit unsigned integer between 0 and 4 G, followed by a cPList which is defined as a parameter list. A cPList is simply a list of any length of pName type values. Command interpreters **625** use tables 2 and 3 to compare predefined script formats with actual scripts for performing script command error checking. Error checking is defined in greater detail with reference to FIGS. **7** and **8**. Generation of a data structure by command interpreters **625** is described in detail with reference to FIGS. **7–10**.

An example variable (or parameter) table is illustrated in table 4 as follows:

TABLE 4

Variable Table

Variable Name	Type	Value
"count"	1	0
"valu"	3	1.25

External and internal command handlers **420** and **650** accordingly send image processor parameters to image processors **430** for setting camera **110** software-based features, or camera parameters to the camera control system **440** for setting capture-related features. Although not shown, command handlers **420**/**650** may send I/O parameters to I/O interface **348** for setting I/O features or other system or control parameters to other managers for setting other camera **110** features. The operations of external command handlers **420** and internal command handlers **630** are described below in greater detail with reference to FIG. **7**B.

Programming statement interpreter **635** uses variable table **645** to process a programming statement such as control, I/O, ALU or documentation statements. For example, a programming statement may be a definition, a mathematical expression, a logical expression, etc.

If one of the script manager **410** components including the tokenizer **620**, the command interpreters **625**, the programming statement interpreter **635**, the internal command handler **630** locates an error in the script message, then the script manager **410** component sends an error message to an error handler **615** of function handlers **610**. The error handler **615** recognizes error codes in the error message, stops script execution and passes an appropriate error message responsively back via function decoder **605** to I/O interface **348**.

FIG. **6**B is a block diagram illustrating the operations of camera **100**. Imaging device **114** captures and converts an image to a digitized image, and stores the digitized image in memory **354**. Image processor **430** takes the raw digitized image and adds image enhancements such as contrast adjustment, sharpening, etc. Image processor **430** stores the enhanced image again in memory **354**.

The operations of imaging device **114** and of image processors **430** can be controlled by active scripts and script feature settings. While executing a script, the script manager **410** retrieves and displays the script feature setting currently-stored in the script data base **536** for the selected script. The script manager **410** can interact with a user via I/O interface **348** to enable modification or the currently-stored script feature setting in order to modify the camera device feature. Script manager **410** generates data structures representing commands within the script, as described below with reference to FIGS. **7**A and **8–10**.

Script manager **410** sends the data structures to external/internal command handlers **420**/**650**, which accordingly send image processor parameters to image processors **430** for setting camera **110** software-based features, camera parameters to camera control software for setting capture features, or other system or control parameters to other appropriate managers. It will be appreciated that a programmer may use host computer **120** to add additional scripts to script data base **536**, for adding additional functions and features to camera **110**.

FIG. **7**A is a flowchart illustrating a method **700** for managing script **536** statements. Method **700** begins in step **702** by tokenizer **620** receiving and parsing a statement. If tokenizer **620** in step **704** determines that the program statement is not a script command, then tokenizer **620** sends the tokens to programming statement interpreters **635**, which in step **706** analyze the statement. Programming statement interpreter **635** in step **708** executes the program statement conventionally. Examples of these statements include control, I/O, ALU and documentation statements. Tokenizer **620** in step **710** determines whether there is another statement in script **536**. If so, then tokenizer **620** returns to step **702**. Otherwise, method **700** ends.

If tokenizer **620** in step **704** determines that the program statement is a script command, then tokenizer **620** sends the token to command interpreters **625** which in step **712** retrieve the command code and the parameter list from the command table **640** illustrated above in Table 2 described with reference to FIG. **6**. Using the command code and the parameter list, command interpreters **625** in step **714** scan the parameters and build a data structure. The step of building a data structure from a command is described in detail with reference to FIG. **8**.

Command interpreters **625** in step **716** forward data structures representing external commands via a response through the function decoder **605** back to the control application **400** to external command handler **420** or data structures representing internal commands to internal command handlers **630** for command execution. Command execution is described below with reference to FIG. **7**B.

Command interpreters **625** in step **718** receive responsive data returned from command handlers **420** or **650**. Command interpreters **625** in step **719** examine the data returned to determine if the data indicates an error. If so, then command interpreters **726** jump to step **726** to report the error. Otherwise, command interpreters **625** continue with step **720** to determine whether the current command includes a receive list. If not, then method **700** returns to step **710**. If so, then command interpreters **625** in step **722** examine the expected parameter type in the receive list.

If the expected parameter type is a constant, then command interpreters **625** determine whether the responsive data matches the expected parameter type. If not, then command interpreters **625** inform the error handler **615**, which in step **726** reports the error and method **700** then ends. Otherwise, command interpreters **625** in step **728** advance four bytes for an integer value, sixteen bytes for a DOS name or thirty-two bytes for a character string to index to the next parameter. Command interpreters **625** in step **730** determine whether another parameter remains in the receive list. If so, then command interpreters **625** return to step **722**. Otherwise, command interpreters **625** return to step **710**.

If command interpreters **625** in step **722** determine that the parameter type is a variable, then command interpreters **625** in step **731** determine if the variable has been defined. If not, then method **700** jumps to step **726** to report the error. Otherwise, command interpreters **625** in step **732** stuff the received data value into the variable and proceed to step **728** to index to the next parameter.

If command interpreters **625** in step **728** determine that the parameter type is a number N followed by the symbol "?", then command interpreters **625** in step **734** extract the value N. Command interpreters **625** in step **736** index past N×4 bytes of responsive data, i.e. N parameters. The type "N?" is used to index past parameters which are known to be unnecessary for performing the current instruction. For example, the command "GetCameraStates(1, 'fmod':3?, abc)" requests the current state of camera **110** focus mode. The responsive data may be "1,'fmod',1,25" where "25 represents the current focus mode state. Parameter "3?" causes command interpreters **625** to jump over the first three parameters "1,'fmod',**1**", and on the next loop stuff the value "25" into the variable "abc." Thus, the function "N?" eliminates examination of parameters known to be unnecessary. Command interpreters **625** then proceed to step **734**.

FIG. **7**B is a flowchart illustrating details of the method **716** for executing a command. Method **716** begins with step **740** by command interpreters **625** determining whether the command is an external command or an internal command. If the command is an external command, then command interpreters **625** in step **742** sends the data structure (which represents the command and the send list) and the response code to function decoder **605**, which decodes and forwards the data structure and response code to control application **400**. Control application **400** in step **744** sends the data structures to the appropriate external command handler **420**. The appropriate external command handler **420** in step **746** executes the command data structure and in step **748** forwards the appropriate response data back to the control application, which in turn calls the script manager **410** with the result. The function decoder **605** sends the response data back to command interpreters **625**. Method **716** then ends.

If in step **740** command interpreters **625** determine that the command is an internal command, then command interpreters **625** in step **750** sends the data structure (which represents the command and the send list) to the appropriate internal command handler **630**. Method **716** then jumps to step **746**.

FIG. **8** further illustrates step **714** of building a data structure. Step **714** begins in step **805** by command interpreters **625** creating a command data structure header. Command interpreters **625** in step **810** get the next parameter and in step **815** determine the parameter type. Command interpreters **625** in step **820** determine if the parameter matches the expected parameter type. For example, by examining table 2 and table 3, command interpreters **625** expect the command "GetCameraStates" to be followed by a send list comprising a cUInteger (1) in turn followed by a cPList (16). If the selected parameter is not a member of the expected parameter type, then command interpreters **625** forward a message to error handler **615**, which in step **825** reports the error via a response through the function decoder **605** to the control application **400**. The control application reports the error to the user. As illustrated by jump symbol "A," method **700** then ends

If the selected parameter is a member of the expected parameter type, then command interpreters **625** in step **830** determine whether the parameter is a constant or a variable. If the parameter is a variable, then command interpreters **625** in step **833** determine if the variable is defined. If not, then method **714** jumps to step **726** (FIG. **7**A) to report the error. Otherwise, command interpreters **625** in step **835** retrieve the value of the variable. If the parameter is a constant, then command interpreters **625** convert the ASCII constant to a value. In either case, command interpreters **625** in step **845** append the value to the send data structure. Command interpreters **625** in step **850** increment the data structure size in the header by 4, 8 or 16 bytes depending on the data type. Command interpreters **625** in step **855** determine if the retrieved parameter is the last parameter. If so, then method **714** ends. If not, then method **714** returns to step **810**.

FIG. **9** is a block diagram illustrating a command send data structure **900**, which comprises a header **905** and appended parameters **930**, generated by command interpreters **625**. Header **905** comprises a command code **910**, a command data length **915**, a command data pointer **920** and a deallocation routine pointer **925**. Parameters **930** may include a plurality of appended parameters **935–945**.

For the example command "GetCameraStates(1, 'fmod':3?,fmod)", command interpreters **625** retrieve the command code "0x0005" for "GetCameraStates" as command code **910**, set command data length **915** to zero and place the value nil into command data pointer **920**. Command interpreters **625** append an address of the subroutine which will dispose of the data structure as a deallocation routine pointer **925**. Command interpreters **625** retrieve the parameter "1" and determine that it matches the expected parameter type cUInteger. Since the parameter is a constant, command interpreters **625** append the 32-bit parameter value representing "1" to the data structure as parameter #1 data **935**. Command interpreters **625** modify command data pointer **920** to point to parameter #1 data **935**, and increment command data length **915** by four bytes. Command interpreters **625** retrieve the parameter "fmod" and determine that it matches the expected parameter type cPList. Since the parameter type is a parameter name constant, external command interpreters **625** append the constant "fmod" to send data structure **900** as parameter #2 data **940**. Command interpreters **625** increment command data length **915** by another four bytes. In this example, there are only two parameters and command data length is eight bytes.

FIG. **10** is a block diagram illustrating a command retrieve data structure **1000**, which comprises a header **1005** and return parameters **1030**. Header **1005** comprises a command error code **1010**, a command data length **1015**, a

command data pointer **1020** and a deallocation routine pointer **1025**. Return parameters **1030** may include parameter #1 data **1035** and parameter #2 data **1040**. Any number of parameters may be included.

As described in FIG. **7**A, command interpreters **625** receive the command receive data structure **1000** as responsive data returned from either external command handlers **420** or internal command handlers **630**. Command interpreters **625** process the receive list "3?,fmod" with the data structure **1030** values.

The foregoing description of the preferred embodiments of the invention is by way of example only, and other variations of the above-described embodiments and methods are provided by the present invention. Components of this invention may be implemented using a programmed general purpose digital computer, using application specific integrated circuits, or using a network of interconnected conventional components and circuits. The embodiments described herein have been presented for purposes of illustration and are not intended to be exhaustive or limiting. Many variations and modifications are possible in light of the foregoing teaching. The system is limited only by the following claims:

What is claimed is:

1. A digital camera system comprising:

an imaging device for receiving picture data;

script memory coupled to the imaging device for storing camera-configuring scripts;

an interface coupled to the script memory for enabling the selection of a script feature setting;

a script manager, coupled to the interface for interpreting the script and the script feature setting, and including

a command interpreter coupled to the script memory,

a programming statement interpreter coupled to the script memory, and

a tokenizer for determining when to send an instruction to the command interpreter and when to send an instruction to the programming statement interpreter;

a command handler coupled to the script manager for processing the script based on the script feature setting to provide a camera feature;

control application memory coupled to the imaging device for controlling the camera features based on camera parameters; and

an image processor coupled to the command handler for controlling a processing of the picture data based on the script feature setting.

2. The system of claim **1**, wherein the command handler includes

an external command handler coupled to the script manager for processing external commands; and

an internal command handler coupled to the script manager for processing internal commands.

3. A digital camera system comprising:

an imaging device for receiving picture data;

script memory coupled to the imaging device for storing camera-configuring scripts and a command;

an interface coupled to the script memory for enabling the selection of a script feature setting;

a script manager coupled to the interface for interpreting the script and the script feature setting, and including an error handler for providing an error report to the interface upon indication of an error in the script, and further including a command table for interpreting the command, and

a command handler coupled to the script manager for processing the script based on the script feature setting to provide a camera feature.

4. The system of claim **3**, further comprising a communications port coupled to the script memory for transferring different scripts from an external host computer to the script memory.

5. A digital camera system, comprising:

means for receiving picture data;

script means, coupled to the means for receiving, for storing a camera-configuring script;

interface means, coupled to the script means, for enabling selection of a script feature setting;

interpretation means, coupled to the interface means, for interpreting the script and the script feature setting, and including

a command interpreter means coupled to the means for receiving,

a programming statement interpreter means coupled to the means for receiving; and

a tokenizer for determining when to send an instruction to the command interpreter means and when to send an instruction to the programming statement interpreter means;

command handler means, coupled to the interpretation means, for processing the script based on the script feature setting to provide a camera feature;

control means, coupled to the means for receiving, for controlling the camera features based on camera parameters; and

image processor means, coupled to the command handler means, for controlling a processing of the picture data based on the script feature setting.

6. The system of claim **5**, wherein the command handler means includes:

external command handler means coupled to the interpretation means for processing external commands; and

internal command handler means coupled to the interpretation means for processing internal commands.

7. A system for using parameter tables to generate a data structure for setting digital camera device features, comprising:

means for receiving including an I/O interface for receiving a camera feature setting command which includes a command name, a feature name and a feature setting from a user;

a command table, coupled to the means for receiving, including command names and corresponding command codes;

a feature table, coupled to the means for receiving, including features, corresponding feature codes, corresponding available feature settings and corresponding feature setting codes;

an interpreter, coupled to the means for receiving, for using the command table and the feature table to generate a data structure having the command code representing the command, the feature code representing the feature and the feature setting code representing the feature setting; and

a command handler, coupled to the interpreter, for processing data structures.

8. A system for using parameter tables to generate a data structure for setting digital camera device features, comprising:

means for receiving a camera feature setting command which includes a command name, a feature name and a feature setting;

a command table, coupled to the means for receiving, including command names and corresponding command codes;

a feature table, coupled to the means for receiving, including features, corresponding feature codes, corresponding available feature settings and corresponding feature setting codes;

an interpreter, coupled to the means for receiving, for using the command table and the feature table to generate a data structure having the command code representing the command, the feature code representing the feature and the feature setting code representing the feature setting; and

an error handler, coupled to the interpreter, for providing an error report upon indication of an error.

9. A method of using parameter tables to generate a data structure for setting digital camera device features, comprising the steps of:

receiving, by an interface, a feature setting command which includes a command name, a feature name and a feature setting;

using, by a script manager, a command table which includes a set of command names and corresponding command codes to extract command codes based on the command names;

using, by the script manager, a feature table which includes a plurality of feature sets, each set including a feature name, a corresponding feature code, corresponding available feature settings and corresponding feature setting code, to extract the corresponding feature code and corresponding feature setting code based on the received feature name and the received feature setting;

generating, by the script manager, a message packet which includes the command code, the feature code and the feature setting code; and

providing an error report upon indication of an error to the interface.

10. The method of claim **9**, further comprising, after generating, the step of using a control application to modify camera parameters for setting camera device features.

11. A method of using parameter tables to generate a data structure for setting digital camera device features, comprising the steps of:

receiving, by an interface, a feature setting command which includes a command name, a feature name and a feature setting;

using, by a script manager, a command table which includes a set of command names and corresponding command codes to extract command codes based on the command names;

using, by the script manager, a feature table which includes a plurality of feature sets, each set including a feature name, a corresponding feature code, corresponding available feature settings and corresponding feature setting code, to extract the corresponding feature code and corresponding feature setting code based on the received feature name and the received feature setting;

generating, by the script manager, a data structure which includes the command code, the feature code and the feature setting code;

forwarding, by the script manager, the data structure to a command handler for processing the data structure; and

sending, by the command handler, responsive data in a predetermined format back to the script manager.

12. The method of claim **11**, further comprising ignoring, by the script manager, a portion of the responsive data based on a flag in the command.

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