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(54) **METHOD AND APPARATUS FOR EVALUATING PERFORMANCE OF MOBILE TERMINAL**

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(57) **ABSTRACT**

A method and an apparatus for evaluating performance of a mobile terminal are provided. The method for evaluating performance of a mobile terminal includes: executing applications of a preset list, extracting storage approach patterns for the executed applications, generating test scenarios for the executed applications using the extracted storage approach patterns, performing benchmarking tests for the applications using the generated test scenarios, and evaluating the mobile terminal based on results of the performed benchmarking tests.

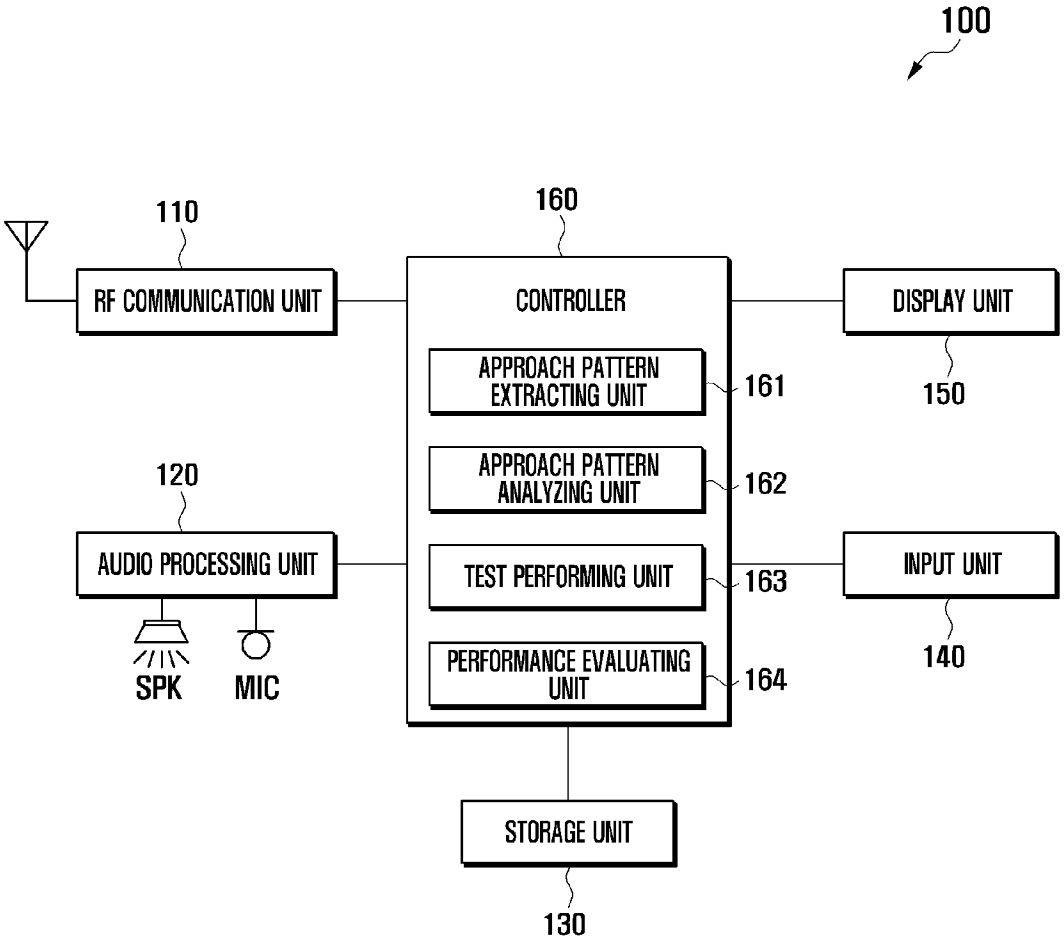


FIG. 1

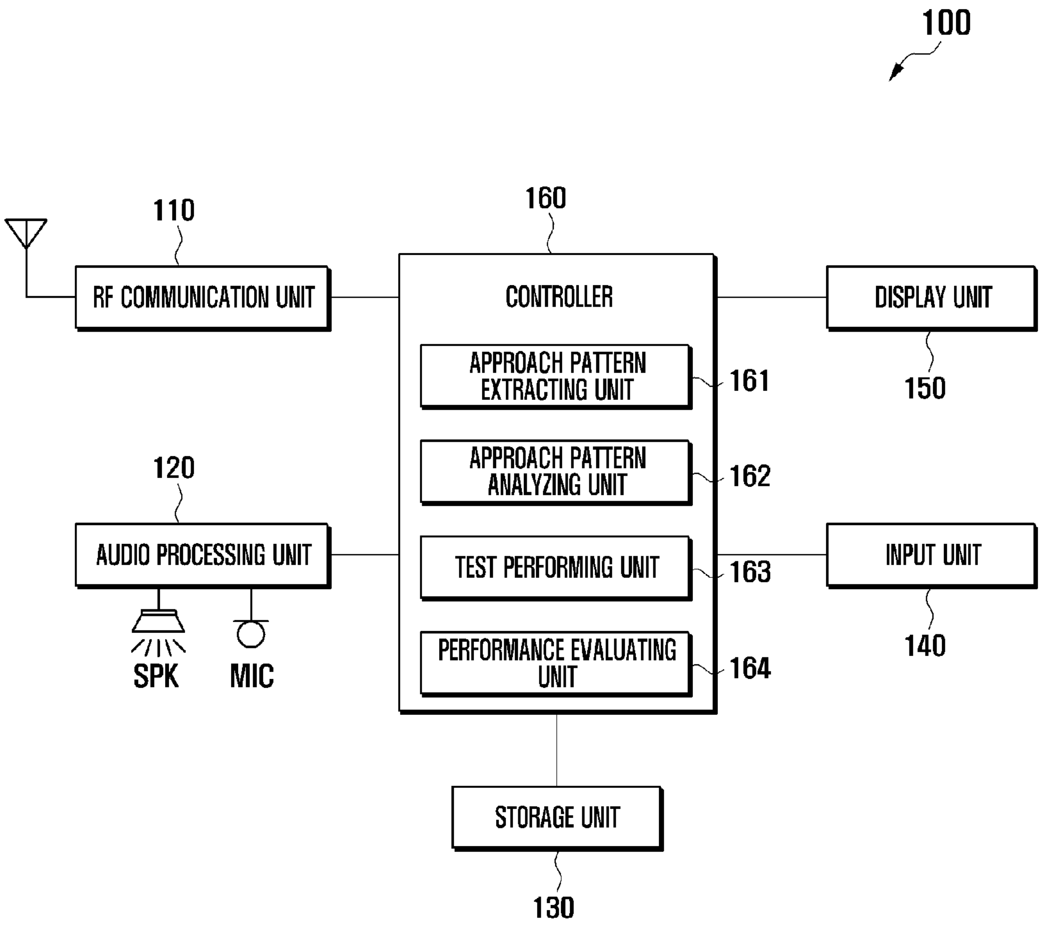

100
110
RF COMMUNICATION UNIT
160
CONTROLLER
APPROACH PATTERN EXTRACTING UNIT
161
APPROACH PATTERN ANALYZING UNIT
162
TEST PERFORMING UNIT
163
PERFORMANCE EVALUATING UNIT
164
DISPLAY UNIT
150
120
AUDIO PROCESSING UNIT
SPK
MIC
INPUT UNIT
140
STORAGE UNIT
130

FIG. 2

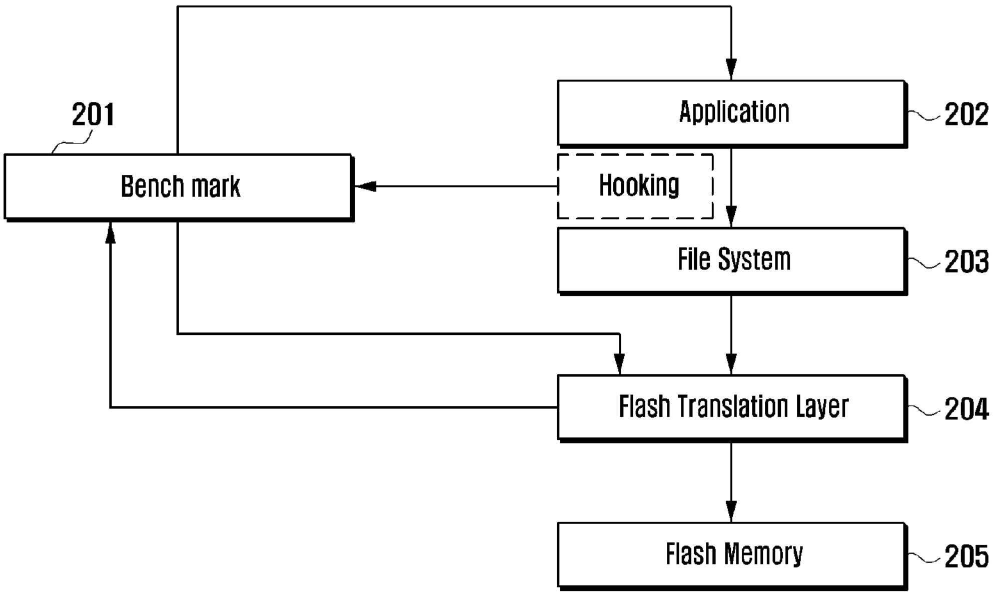

201
Bench mark
Application
202
Hooking
File System
203
Flash Translation Layer
204
Flash Memory
205

FIG. 3

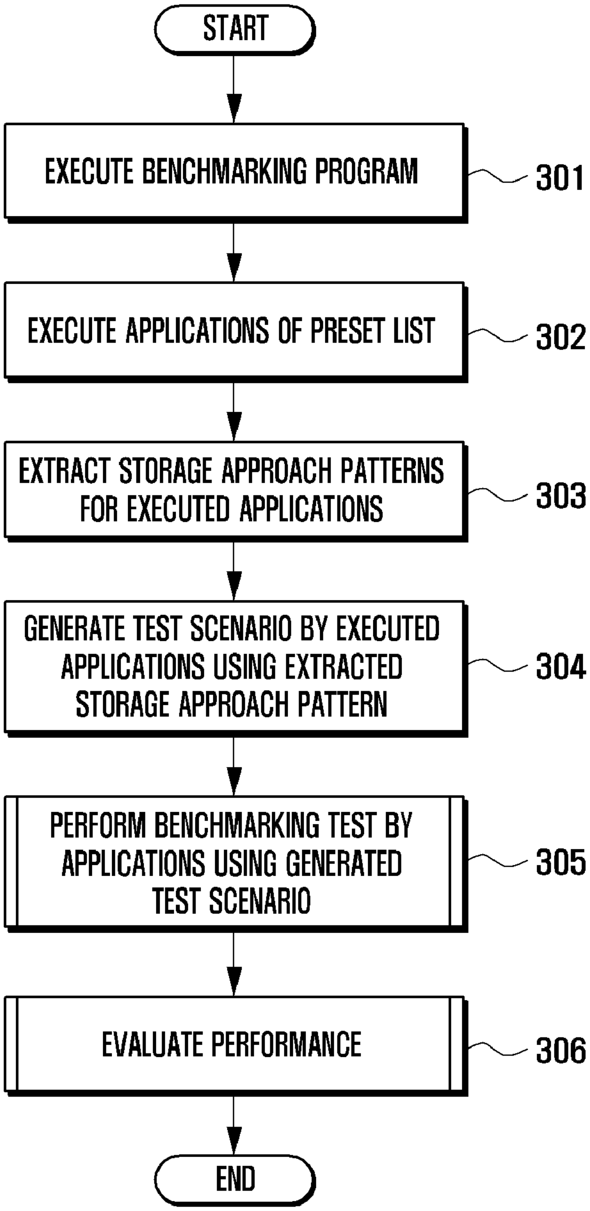

START
EXECUTE BENCHMARKING PROGRAM
301
EXECUTE APPLICATIONS OF PRESET LIST
302
EXTRACT STORAGE APPROACH PATTERNS FOR EXECUTED APPLICATIONS
303
GENERATE TEST SCENARIO BY EXECUTED APPLICATIONS USING EXTRACTED STORAGE APPROACH PATTERN
304
PERFORM BENCHMARKING TEST BY APPLICATIONS USING GENERATED TEST SCENARIO
305
EVALUATE PERFORMANCE
306
END

FIG. 4

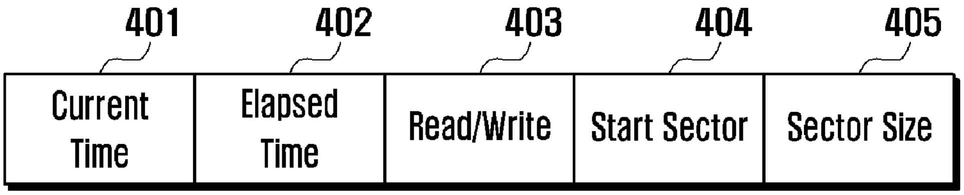
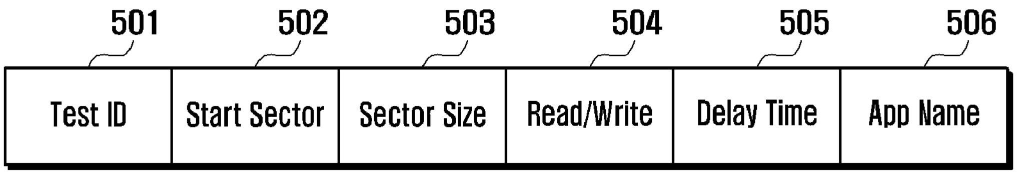

401
402
403
404
405
Current Time
Elapsed Time
Read/Write
Start Sector
Sector Size

FIG. 5



501	502	503	504	505	506
Test ID	Start Sector	Sector Size	Read/Write	Delay Time	App Name

FIG. 6

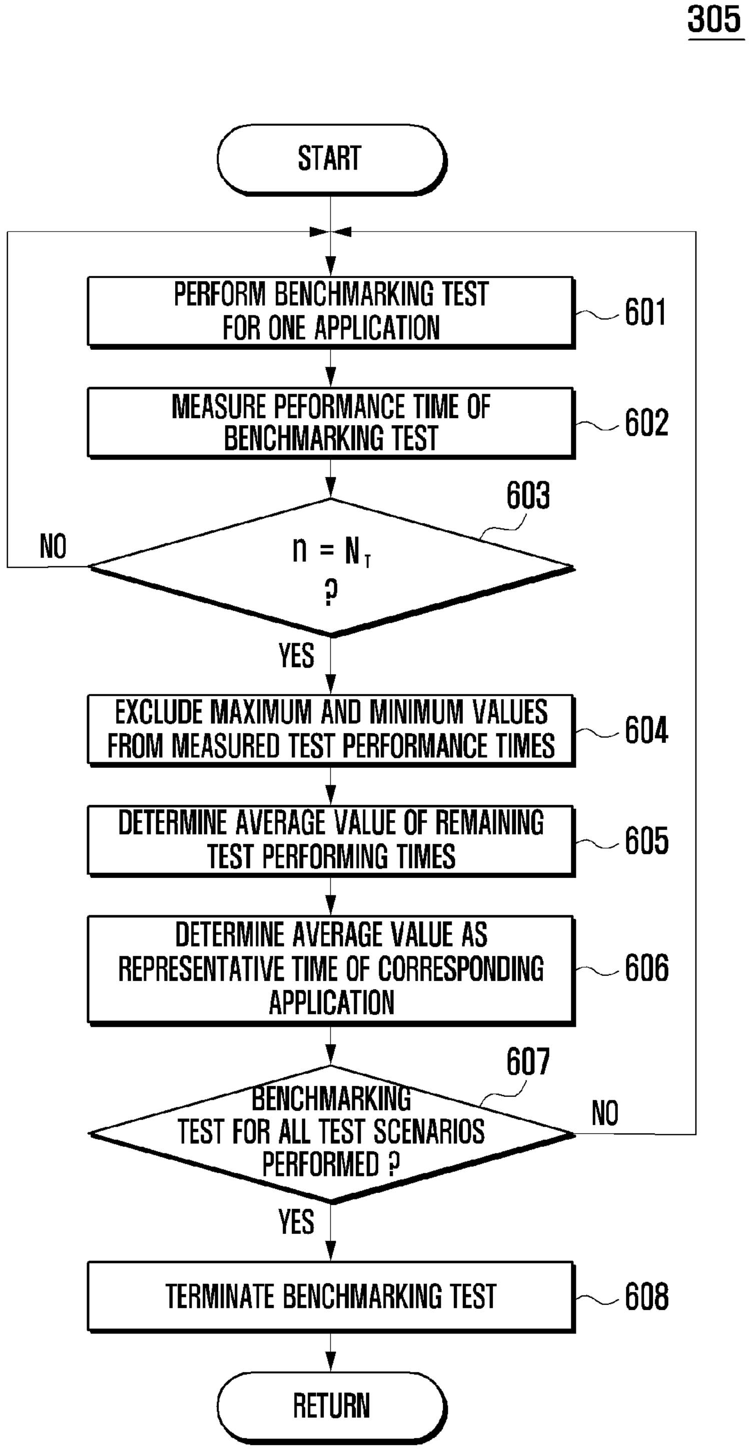

305
START
PERFORM BENCHMARKING TEST FOR ONE APPLICATION
601
MEASURE PEFORMANCE TIME OF BENCHMARKING TEST
602
603
n = N_T ?
NO
YES
EXCLUDE MAXIMUM AND MINIMUM VALUES FROM MEASURED TEST PERFORMANCE TIMES
604
DETERMINE AVERAGE VALUE OF REMAINING TEST PERFORMING TIMES
605
DETERMINE AVERAGE VALUE AS REPRESENTATIVE TIME OF CORRESPONDING APPLICATION
606
607
BENCHMARKING TEST FOR ALL TEST SCENARIOS PERFORMED ?
NO
YES
TERMINATE BENCHMARKING TEST
608
RETURN

FIG. 7

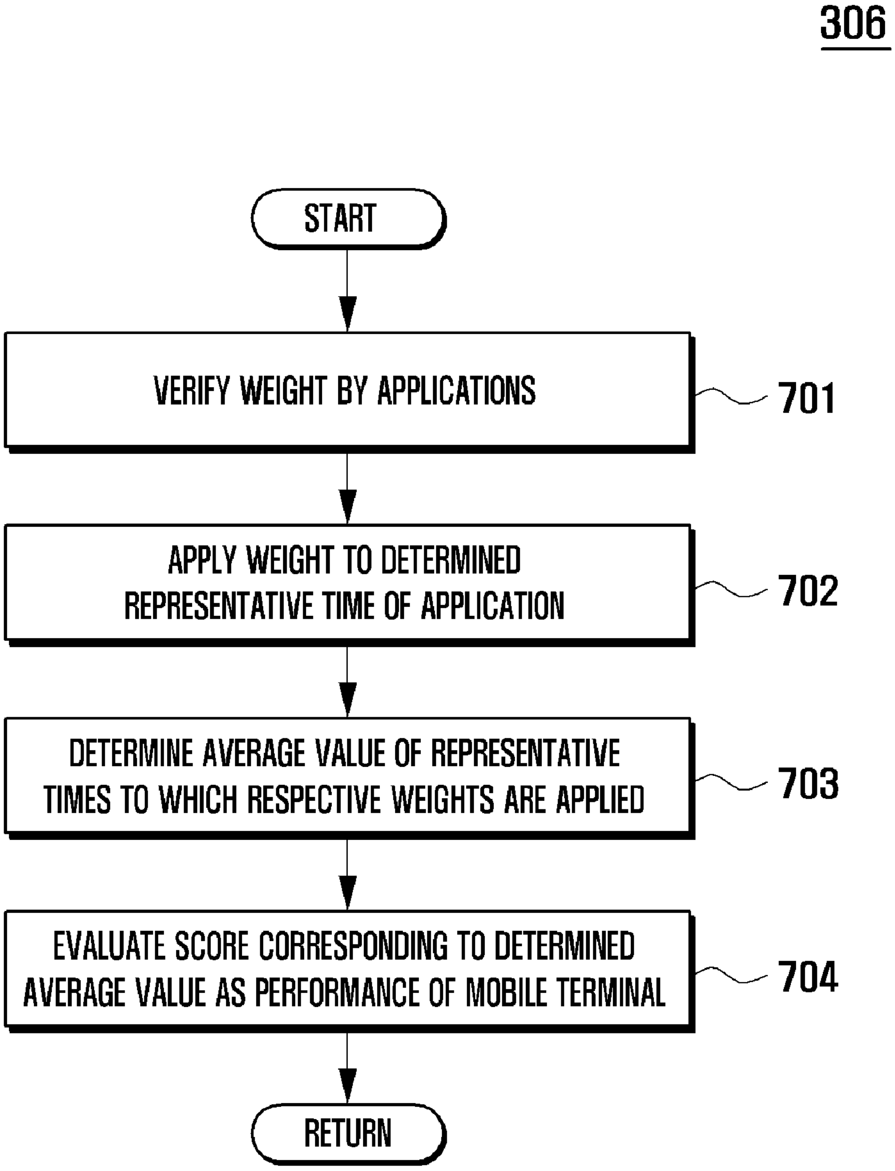
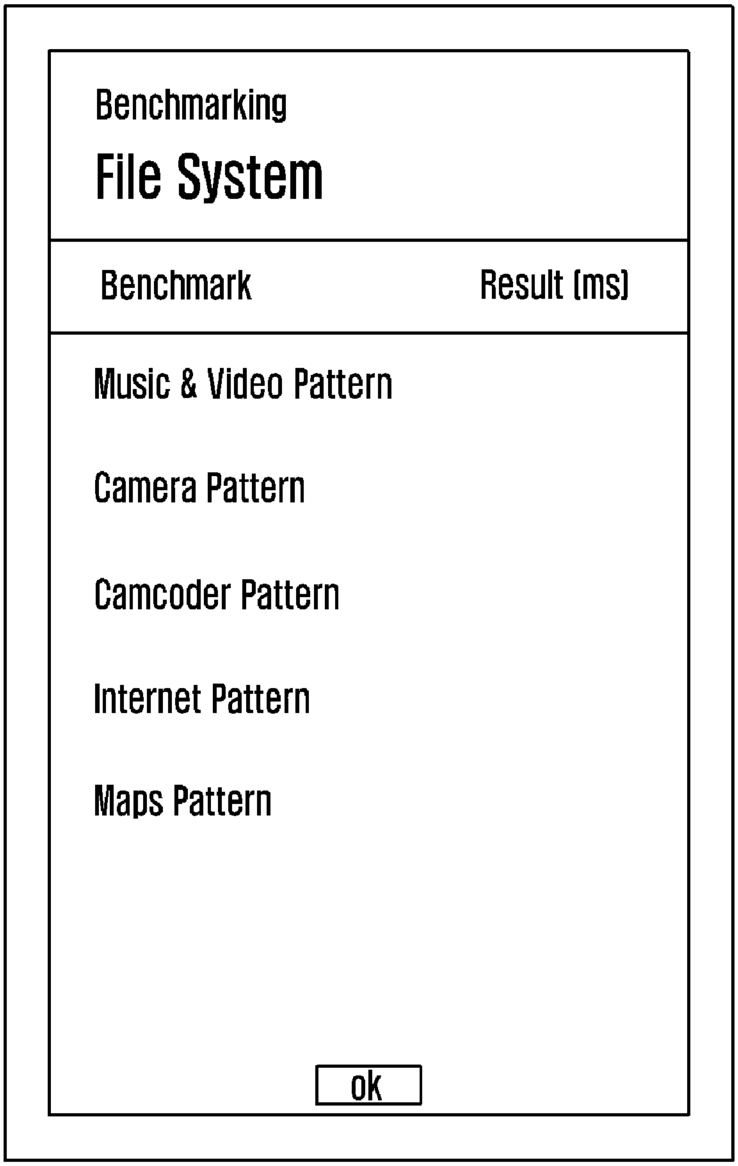

306
START
VERIFY WEIGHT BY APPLICATIONS
701
APPLY WEIGHT TO DETERMINED REPRESENTATIVE TIME OF APPLICATION
702
DETERMINE AVERAGE VALUE OF REPRESENTATIVE TIMES TO WHICH RESPECTIVE WEIGHTS ARE APPLIED
703
EVALUATE SCORE CORRESPONDING TO DETERMINED AVERAGE VALUE AS PERFORMANCE OF MOBILE TERMINAL
704
RETURN

FIG. 8

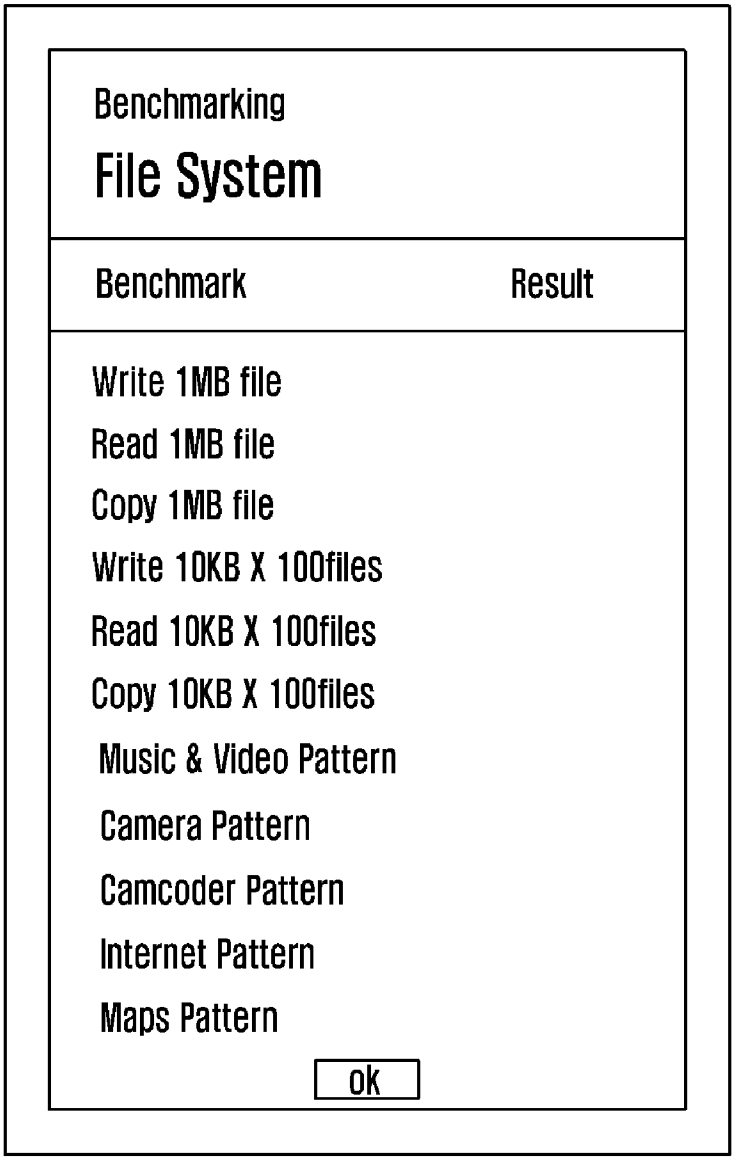


Benchmarking

File System

Benchmark	Result (ms)
Music & Video Pattern	
Camera Pattern	
Camcoder Pattern	
Internet Pattern	
Maps Pattern	

FIG. 9

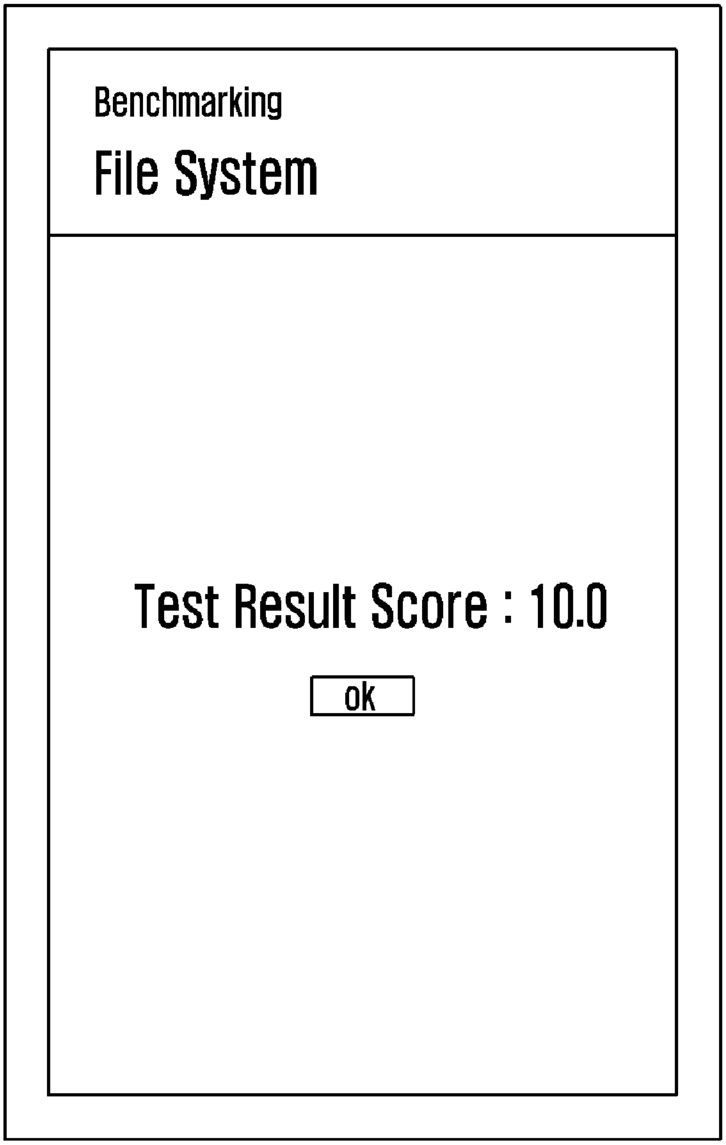


Benchmarking

File System

Benchmark	Result
Write 1MB file	
Read 1MB file	
Copy 1MB file	
Write 10KB X 100files	
Read 10KB X 100files	
Copy 10KB X 100files	
Music & Video Pattern	
Camera Pattern	
Camcoder Pattern	
Internet Pattern	
Maps Pattern	

FIG. 10



Benchmarking

File System

Test Result Score : 10.0

METHOD AND APPARATUS FOR EVALUATING PERFORMANCE OF MOBILE TERMINAL

PRIORITY

[0001] This application claims the benefit under 35 U.S.C. §119(a) of a Korean patent application filed on Jan. 5, 2011 in the Korean Intellectual Property Office and assigned Serial No. 10-2011-0000718, the entire disclosure of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a method and an apparatus for evaluating performance of a mobile terminal More particularly, the present invention relates to a method for analyzing storage approach patterns for applications installed in a mobile terminal to evaluate performance of the mobile terminal, and an apparatus implementing the same.

[0004] 2. Description of the Related Art

[0005] Recently, with increased use of a mobile terminal, the mobile terminal has become popular. The mobile terminal may provide functions such as a unique voice call service, various data transmission services and various additional services, and has been used as a multimedia communication device.

[0006] There are various types of mobile terminals and performance differs according to type. In general, upon evaluating the mobile terminal, clocks of a Central Processing Unit (CPU), the size of a memory, capacity of a battery, and a type of LCD are evaluated. The time taken to execute 1 MB read/write/copy or 10 KB×100 files read/write/copy in a storage installed in the mobile terminal is measured to evaluate performance of the mobile terminal.

[0007] A variety of applications are provided in the mobile terminal Since a method for evaluating performance as illustrated above is not a method based on an Input/Output (I/O) pattern upon driving a real application, it is difficult to determine that an evaluation result objectively reflects performance of a mobile terminal.

SUMMARY OF THE INVENTION

[0008] Aspects of the present invention are to address at least the above-mentioned problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present invention is to provide a method for evaluating performance of a mobile terminal capable of reflecting the performance of the mobile terminal, and an apparatus thereof.

[0009] In accordance with an aspect of the present invention, a method for evaluating performance of a mobile terminal is provided. The method includes executing applications of a preset list, extracting storage approach patterns for the executed applications, generating test scenarios for the executed applications using the extracted storage approach patterns, performing benchmarking tests for the applications using the generated test scenarios, and evaluating the mobile terminal based on results of the performed benchmarking tests.

[0010] In accordance with another aspect of the present invention, a mobile terminal is provided. The mobile terminal includes a storage unit for storing at least one application and benchmarking program, an approach pattern extracting unit for extracting storage approach patterns by executed applications, an approach pattern analyzing unit for generating test scenarios for the executed applications using the extracted storage approach patterns, a test performing unit for performing benchmarking tests by applications using the generated test scenarios, and a performance evaluating unit for evaluating performance of the mobile terminal using results of the performed benchmarking tests.

[0011] Exemplary embodiments of the present invention generate a test scenario using an approach pattern indicating how to approach a storage unit for every executed application and perform a benchmarking test using the generated test scenario. That is, since the present invention generates a test scenario according to an approach pattern by directly executing an application, it may reflect a real application operation. Accordingly, the present invention may evaluate performance of the mobile terminal more exactly and objectively.

[0012] Other aspects, advantages, and salient features of the invention will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses exemplary embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above and other aspects, features, and advantages of certain exemplary embodiments of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

[0014] FIG. **1** is a block diagram illustrating a configuration of a mobile terminal according to an exemplary embodiment of the present invention;

[0015] FIG. **2** is a view illustrating a protocol stack of a benchmarking system according to an exemplary embodiment of the present invention;

[0016] FIG. **3** is a flowchart illustrating a method for evaluating performance of a mobile terminal according to an exemplary embodiment of the present invention;

[0017] FIG. **4** is a view illustrating a data format of a storage access pattern according to an exemplary embodiment of the present invention;

[0018] FIG. **5** is a view illustrating a data format of a test scenario according to an exemplary embodiment of the present invention;

[0019] FIG. **6** is a flowchart illustrating a procedure for benchmarking tests for applications using generated test scenarios according to an exemplary embodiment of the present invention;

[0020] FIG. **7** is a flowchart illustrating a procedure for evaluating performance of a mobile terminal using results of performed benchmarking tests according to an exemplary embodiment of the present invention;

[0021] FIG. **8** and FIG. **9** are views illustrating execution screens of a benchmarking program according to an exemplary embodiment of the present invention; and

[0022] FIG. **10** is a view illustrating an execution screen of a benchmarking program according to an exemplary embodiment of the present invention.

[0023] Throughout the drawings, it should be noted that like reference numbers are used to depict the same or similar elements, features, and structures.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0024] The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments of the invention as defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions may be omitted for clarity and conciseness.

[0025] The terms and words used in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the invention. Accordingly, it should be apparent to those skilled in the art that the following description of exemplary embodiments of the present invention is provided for illustration purpose only and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

[0026] It is to be understood that the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a component surface" includes reference to one or more of such surfaces.

[0027] As used herein, the term "Benchmarking" denotes an operation and a system for measuring and evaluating performance of a mobile terminal Concretely, the Benchmarking is an operation for measuring and evaluating performance of a file system in the mobile terminal. As used herein, the term "Benchmarking program" denotes an application for evaluating performance of a mobile terminal and is stored in a storage unit in the mobile terminal As used herein, the term "Benchmarking test" denotes a test that executes an application according to a test scenario to measure execution time and evaluates performance of the mobile terminal for the measured execution time.

[0028] As used herein, the term "File System" denotes a system approaching a storage installed in the mobile terminal In the mobile terminal, if an application approaches a file system, the file system approaches a flash memory as the storage through a Flash Translation Layer. The file system may include a File System Driver (FSD) Manager, a Cache Manager, an Extended File Allocation Table ExFAT file system, a Disk Cache, a Partition Driver, and a Block Driver.

[0029] The mobile terminal according to an exemplary embodiment of the present invention may be an information communication device and a multimedia device such as a Portable Multimedia Player (PMP), a Personal Digital Assistant (PDA), a Smart Phone, or a Moving Picture Experts Group (MPEG)-1 or MPEG-2 Audio Layer 3 (MP3) player.

[0030] FIG. **1** is a block diagram illustrating a configuration of a mobile terminal according to an exemplary embodiment of the present invention.

[0031] Referring to FIG. **1**, the mobile terminal **100** includes a Radio Frequency (RF) communication unit **110**, an audio processing unit **120**, a storage unit **130**, an input unit **140**, a display unit **150**, and a controller **160**.

[0032] The RF communication unit **110** performs transmitting and receiving functions of corresponding data for RF communication. The RF communication unit **110** may include a transmitter (not illustrated) for up-converting a frequency of a transmitted signal and for amplifying the signal, a receiver (not illustrated) for low-noise-amplifying a received signal and for down-converting the signal. Further, the RF communication unit **110** receives data through an RF channel and outputs the received data to the controller **160**. The RF communication unit **110** may transmit data output from the controller **160** through the RF channel.

[0033] The audio processing unit **120** may be configured by a COder-DECoder (CODEC). The CODEC may include a data CODEC processing packet data and an audio CODEC processing an audio signal. The audio processing unit **120** converts a digital audio signal into an analog audio signal using the audio CODEC, and plays the analog audio signal using a Speaker (SPK). The audio processing unit **120** converts an analog audio signal input from a Microphone (MIC) into a digital audio signal using the audio CODEC.

[0034] The storage unit **130** stores programs and data necessary for an operation of the mobile terminal **100**. The storage unit **130** may be divided into a program area and a data area. The program area stores a program for controlling an overall operation of the mobile terminal **100**, an Operating System (OS) booting the mobile terminal **100**, and other applications. The other applications may include an Internet browser application, a map searching application, a music and video playing application, a photographing application, and a moving image photographing application, and the like. The data area is an area for storing data created according to use of the mobile terminal **100**, and may store images, moving images, phone-books, audio data, and the like.

[0035] The storage unit **130** according to an exemplary embodiment of the present invention may be configured by a flash memory. More particularly, the flash memory may be configured by an Embedded NAND Flash Memory such as an iNAND or a moviNAND. In a case of the iNAND, a Flash Translation Layer is mounted as a Firmware, read speed is 30 MB/sec, write speed is 12 MB/sec, and a driving voltage of 3.3V is required. Maximum capacity of the moviNAND is 32 GB, maximum speed thereof is 52 MB/sec, and the moviNAND requires a driving voltage of 3.3V.

[0036] The storage unit **130** also stores a benchmarking program for measuring performance of the mobile terminal **100**. Further, the storage unit **130** stores a list of applications to be executed, information on storage approach patterns for applications, information regarding test scenarios for applications upon execution of a benchmarking program, and information regarding weights applied by applications upon evaluating of performance.

[0037] The input unit **140** receives a key operation signal of a user for controlling the mobile terminal **100** and transfers the received key operation signal to the controller **160**. The input unit **140** may be configured by a key pad such as a 3*4 pad or a QWERTY pad including numeral keys, character keys, and arrow keys or a touch panel. Further, the input unit **140** may be configured by a button key, a jog key, a wheel key, and the like. The input unit **140** generates and transfers an input signal executing applications (e.g., a call function, a music playing function, a moving image playing function, an image display function, a camera photographing function, or a Digital Multimedia Broadcasting (DMB) output function) of the mobile terminal according to user input.

[0038] The display unit **150** may be configured by a Liquid Crystal Display (LCD), an Organic Light Emitting Diode (OLED), or an Active Matrix Organic Light Emitting Diode (AMOLED). The display unit **160** visibly provides a menu of the mobile terminal **100**, input data, function setting information, and a variety of other information to a user. The display unit **150** performs a function for outputting a booting screen, an idle screen, a menu screen, a call screen, and other application screens of the mobile terminal **100**. The display unit **150** also separates and displays representative times of respective applications corresponding to benchmarking test execution results by applications. Further, the display unit **150** displays a benchmarking test result screen including a performance score of the mobile terminal **100**.

[0039] The controller **160** controls an overall operation with respective structural elements of the mobile terminal

100. The controller **160** includes an approach pattern extracting unit **161**, an approach pattern analyzing unit **162**, a test performing unit **163**, and a performance evaluating unit **164**.

[0040] The approach pattern extracting unit **161** extracts storage approach patterns for executed applications. Upon executing applications, the approach pattern extracting unit **161** hooks a file system to extract storage approach patterns for applications. A file system stage in a protocol stack of a storage approach is located under an application stage. The approach pattern extracting unit **161** retrieves an approach pattern between the application stage and the file system stage. The storage approach pattern may include a current time after booting the mobile terminal, an elapsed Time of operation, a type (Read/Write) of operation, a Start Sector which an Input/Output (I/O) Request approaches, and the Sector Size.

[0041] The approach pattern analyzing unit **162** generates test scenarios for executed applications using the extracted storage approach pattern. The approach pattern analyzing unit **162** determines a statistic value on whether the size of approached data is small or large, and a statistic value on whether an approach location is sequential or random to generate a test scenario with respect to how to benchmark. The test scenario may include Test IDentification (ID), a Start Sector, a Sector Size, a type (Read/Write) of operation, a Delay Time with next test, and an application name.

[0042] The test performing unit **163** performs benchmarking tests for applications using the generated test scenarios. The test performing unit **163** according to an exemplary embodiment of the present invention performs the benchmarking test using the generated test scenarios with respect to an application executed for extracting a storage approach pattern, performs tests for applications, for preset times, to measure test performing times, determines an average of the test performing times, and determines the determined average as representative time of a corresponding application.

[0043] The performance evaluating unit **164** evaluates performance of a mobile terminal **100** using results of the performed benchmarking test. The performance evaluating unit **164** verifies weights allotted by applications in which a benchmarking test is performed from the storage unit **130**, applies a corresponding weight to the determined representative times of applications, respectively, determines an average of representative times of applications to which the weight is applied, and evaluates a score corresponding to the determined average as performance of the mobile terminal.

[0044] FIG. **2** is a view illustrating a protocol stack of a benchmarking system according to an exemplary embodiment of the present invention.

[0045] The protocol stack of a benchmarking system consists of a benchmark **201**, an application **202**, a file system **203**, a flash translation layer **204**, and a flash memory **205**.

[0046] The benchmark **201**, the application **202**, the file system **203**, and the flash translation layer **204** are software layers, and the flash memory **205** is a hardware layer.

[0047] The file system **203** may be configured by a File Allocation Table 32 (FAT32) file system, or an ExFAT file system. The sector size in the ExFAT file system may use 512~4096 bytes, and 2,796,202 files may be stored in one directory.

[0048] A procedure for evaluating performance of a mobile terminal **100** according to an exemplary embodiment of the present invention is performed in the benchmark **201**. The approach pattern extracting unit **161**, the approach pattern analyzing unit **162**, the test performing unit **163**, and the performance evaluating unit **164** are included in the benchmark **201**.

[0049] If the benchmark **201** executes an application **202**, the application **202** approaches a file system **203**. At this time, the benchmark **201** hooks a pattern that an application **202** approaches between the application **202** and the file system **203** to extract an approach pattern. The benchmark **201** extracts a current time after booting the mobile terminal, an elapsed Time of operation, a type (Read/Write) of operation, a Start Sector that I/O Request approaches, and a Sector Size as the approach pattern, and temporarily stores them.

[0050] The benchmark **201** generates a test scenario using approach patterns extracted for applications **202**. The benchmark **201** applies the generated scenarios to the flash translation layer **204** to perform the benchmarking test, and receives a benchmarking test performing result from the flash translation layer **204**. The benchmark **201** performs a benchmarking test for one application, for preset times, to retrieve a plurality of test performing results from the flash translation layer **204**. The test performing result corresponds to an elapsed time of test performing.

[0051] The benchmark **201** determines representative times for applications using a plurality of test performing results from the flash translation layer **204**. The benchmark **201** determines an average of test performing times measured for applications and determines the average thereof as a representative time of a corresponding application.

[0052] The benchmark **201** evaluates performance of the mobile terminal **100** using the determined representative time of an application. The benchmark **201** applies weights to representative times for applications, determines an average of representative times of an application to which the weights are applied, and evaluates performance of the mobile terminal **100** with a score corresponding to the determined average thereof.

[0053] The foregoing exemplary embodiment of the present invention has described an internal construction of the mobile terminal evaluating performance and the protocol stack of a benchmark system. Hereinafter, a method for evaluating performance in the mobile terminal **100** will be described.

[0054] FIG. **3** is a flowchart illustrating a method for evaluating performance of a mobile terminal according to an exemplary embodiment of the present invention.

[0055] Referring to FIG. **3**, a controller **160** executes a benchmarking program stored in a storage unit **130** at step **301**. The benchmarking program refers to an application for evaluating performance of the mobile terminal **100**. A benchmarking program execution menu is included in the mobile terminal **100**, and a user may execute the benchmarking program through an input unit **140** using the benchmarking program execution menu.

[0056] If the benchmarking program is executed according to user input, the controller **160** executes applications of a preset list at step **302**. In order to evaluate the performance of the mobile terminal **100**, the present invention executes at least one application installed in the mobile terminal **100** to extract a storage approach pattern. At this time, the executed application may be configured by the most frequently used applications in the mobile terminal **100**. The controller **160** constructs one list with the most frequently used applications. When executing the benchmarking program, the controller **160** may execute applications included in the list. The application list may be fixed or changed according to a user setting. Further, upon execution of the applications, the controller **160** may measure an execution frequency for every application and reflect a rank of the execution frequency to construct the application list. The controller **160** may execute five applications, namely, an Internet Browser application, a Map searching application, a Music & Video application, a camera photographing application, and a moving image (e.g., a camcorder) application at step **302**.

[0057] After executing one or more applications, an approach pattern extracting unit **161** extracts storage approach patterns for executed applications at step **303**. Referring to FIG. **2**, after the approach pattern extracting unit **161** in the benchmark **201** executes the application **202**, it hooks a file system to extract storage approach patterns for the applications. The storage approach pattern may be composed of a current time after booting the mobile terminal, an elapsed Time of operation, a type (Read/Write) of operation, a Start Sector that I/O Request approaches, and a Sector Size.

[0058] FIG. **4** is a view illustrating an example of a data format of a storage access pattern according to an exemplary embodiment of the present invention.

[0059] Referring to FIG. **4**, the data format of a storage approach pattern includes a Current Time region **401**, an Elapsed Time region **402**, a Read/Write region **403**, a Start Sector region **404**, and a Sector Size region **405**. The Current Time region **401** includes a current time after booting the mobile terminal **100**. The Elapsed Time region **402** includes time taken to perform an operation such as Read, Write, or Copy. The Read/Write region **403** includes a type of operation indicating whether I/O is read or write. The Start Sector region **404** includes an occurrence location of the I/O or a Logical Sector Address. The Sector Size region **405** includes the size of a sector in which the I/O occurs.

[0060] In an exemplary implementation, the approach pattern extracting unit **161** may additionally extract 'input/output occurrence time' as the storage approach pattern. The storage approach pattern is classified into a continuous pattern in which a next I/O comes directly after one I/O finishes, a pause pattern having rest time during the I/O operation, and a burst pattern generating many I/Os once and having rest time during the I/O operation.

[0061] If the approach pattern extracting unit **161** extracts the storage approach patterns, the approach pattern analyzing unit **162** generates test scenarios for executed applications using the extracted storage approach patterns at step **304**. To objectively evaluate performance of the mobile terminal **100**, the performance of the mobile terminal **100** is not directly evaluated based on the extracted storage approach pattern itself, but the approach pattern analyzing unit **162** generates test scenarios with the extracted storage approach patterns. That is, the approach pattern analyzing unit **162** determines statistic values on whether the size of approached data is small or large and on whether an approach location is sequential or random to generate the test scenarios. The test scenario may include a Test ID, a Start Sector, a Sector Size, a type (Read/Write) of operation, a Delay Time with a next test, and an application (App) name.

[0062] FIG. **5** is a view illustrating an example of a data format of a test scenario according to an exemplary embodiment of the present invention.

[0063] Referring to FIG. **5**, the data format of a test scenario includes a Test ID region **501**, a Start Sector region **502**, a Sector Size region **503**, a Read/Write region **504**, a Delay Time region **505**, and an App Name region **506**. The Test ID region **501** includes a unique identification of a test. The unique identification of the test may be an order of tests. The Start Sector region **502** includes an occurrence location of I/O, a Logical Sector Address, or a Logical Block Address. The occurrence location of I/O may contain information on whether the occurrence location is sequential, random, linearly increased or reduced, and on whether a partition is designated.

[0064] The Sector Size region **503** may include the size of a sector in which I/0 occurs, and information on whether the size of data is small or large. For example, a small data size may be 10 KB, and a large data size may be 1 MB.

[0065] The Read/Write region **504** includes a type of operation indicating whether I/O is read or write. The Delay Time region **505** includes time intervals between tests. The App Name **506** includes an application name.

[0066] If the approach pattern analyzing unit **162** generates test scenarios for applications, the test performing unit **163** performs benchmarking tests for applications using the generated test scenarios at step **305**. The test performing unit **163** performs a benchmarking test for an application executed to extract the storage approach pattern using a test scenario, and determines representative performing times for applications. The benchmarking tests for applications using the generated test scenarios will be described in more detail with reference to FIG. **6**.

[0067] If the test performing unit **163** performs benchmarking tests for applications, the performance evaluating unit **164** evaluates performance of the mobile terminal **100** using results of the performed benchmarking tests at step **306**. The performance evaluating unit **164** puts representative execution times for applications together to evaluate the entire performance of the mobile terminal **100**. The evaluation of the performance of the mobile terminal using results of the performed benchmarking tests will be described in more detail with reference to FIG. **7**.

[0068] FIG. **6** is a flowchart illustrating a procedure for benchmarking tests for applications using generated test scenarios according to an exemplary embodiment of the present invention.

[0069] Referring to FIG. **6**, a test performing unit **163** performs a benchmarking test for one of the applications in which a test scenario is generated according to the test scenario at step **601**. In an exemplary implementation, the test performing unit **163** may perform the benchmarking test at step **601** in an execution order of applications at step **302** of FIG. **3**. The test performing unit **163** determines an application to be executed by referring to a Test ID and an App Name, executes an application by referring to a Sector Start, a Sector Size, a type (Read/Write) of operation, and executes a next application by referring to a Delay Time between tests.

[0070] The test performing unit **163** measures a performance time of a benchmarking test at step **602**. After executing the application, the test performing unit **163** measures the time for performing an operation (i.e., read or write) with respect to a corresponding Sector Start and Sector Size.

[0071] In an exemplary implementation, the test performing unit **163** performs a benchmarking test for one application plural times, and determines whether the number n of the benchmarking tests is a preset number (N_T) at step **603**. The N_T is the minimum test measuring number required to determine representative time of an application. When the n does not become the N_T, the test performing unit **163** returns to step **601** and repeats a benchmarking test for one application. At this time, the test performing unit **163** repeats a benchmarking test by referring to a Delay Time region **505** constituting the test scenario.

[0072] If the n becomes the N_T at step **603**, the test performing unit **163** excludes a maximum value and a minimum value from measured test performance times at step **604**. Because the maximum value and the minimum value may be used as error, the test performing unit **163** excludes the maximum value and the minimum value.

[0073] Next, the test performing unit **163** determines an average value of remaining test performing times except for the maximum value and the minimum value at step **605**. For example, when the test performing unit **163** performs a benchmarking test for one application 13 times, it determines an average value of 11 test performing times except for the maximum value and the minimum value.

[0074] Subsequently, the test performing unit **163** determines the determined average value as a representative time of a corresponding application at step **606**.

[0075] The test performing unit **163** determines whether respective benchmarking test for all test scenarios are performed at step **607**. For example, when the approach pattern analyzing unit **162** generates respective test scenarios with respect to five applications at step **304**, the test performing unit **163** determines whether benchmarking tests for five test scenarios are all performed at step **607**.

[0076] When there are test scenarios not performing the benchmarking test, the test performing unit **163** returns to step **601** and performs a benchmarking test according to a next test scenario. At this time, the test performing unit **163** performs a benchmarking test of a next application by referring to a Delay Time region **505** constituting a test scenario.

[0077] When the respective bench marking tests for all the test scenarios are performed, the test performing unit **163** terminates the benchmarking test at step **608**.

[0078] In an exemplary implementation, after step **608**, the test performing unit **163** may control the display unit **150** to display representative times determined for every application, respectively. A user may verify the time taken for a storage approach of every application through representative times for the applications.

[0079] In addition, the test performing unit **163** may not exclude the maximum value and the minimum value from the measured test performing times, determines an average value of all the measured test performing times, and determines the determined average value as a representative time of a corresponding application.

[0080] FIG. **7** is a flowchart illustrating a procedure for evaluating performance of a mobile terminal using results of performed benchmarking tests according to an exemplary embodiment of the present invention.

[0081] Referring to FIG. **7**, a performance evaluating unit **164** verifies weights by applications at step **701**. In an exemplary implementation, users do not use all applications with the same frequency. There are frequently used applications and applications which are not used frequently. The used frequency is a weight which may be applied to evaluate performance of the mobile terminal **100**. The weight may be stored in a storage unit **130** as a fixed value for every application, and may be changed according to change in the used frequency. That is, the controller **160** may measure used frequencies by applications, change and set a weight according to the used frequency, and store the set weight in the storage unit **130**. Further, the controller **160** measures an I/O overhead. As the I/O overhead increases, the controller **160** may set the weight higher.

[0082] The performance evaluating unit **164** verifies weights allotted by applications in which a benchmarking test is performed from the storage unit **130** at step **701**.

[0083] Next, the performance evaluating unit **164** applies respective weights to determine representative times of an application at step **702**. For example, when respective representative times for five applications are determined, the performance evaluating unit **164** multiplies representative times by weights corresponding to respective applications to determine representative times to which five weights are applied, respectively.

[0084] The performance evaluating unit **164** determines an average value of the representative times to which the respective weights are applied at step **703**. That is, respective benchmarking tests for five applications are performed and the performance evaluating unit **164** determines an average value of five representative times to which respective weights are applied.

[0085] Subsequently, the performance evaluating unit **164** evaluates a score corresponding to the determined average value as the performance of the mobile terminal at step **704**. A score table composed of average values of representative times to which respective weights are applied is stored in the storage unit **130**. For example, the score is set as one from 0 to 10, and respective scores may be set corresponding to a range of average values of representative times to which respective weights are applied. After determining the average value, the performance evaluating unit **164** determines a score corresponding to the determined average value as the performance of the mobile terminal **100**.

[0086] In an exemplary implementation, the performance evaluating unit **164** may control the display unit **150** to display a performance evaluating score of the mobile terminal **100**. Further, in a case where the test performing unit **130** displays representative times and confirm keys of respective applications through the display unit **150**, if a user input the confirm key through the input unit **140**, after performing step **701** to step **704**, the performance evaluating unit **164** controls the display unit **150** to display the performance evaluating score of the mobile terminal **100**.

[0087] FIG. **8** and FIG. **9** are views illustrating examples of an execution screen of a benchmarking program according to an exemplary embodiment of the present invention, respectively. FIG. **8** and FIG. **9** illustrate screens displaying representative times of respective applications after performing benchmarking tests with respect to respective applications.

[0088] Referring to FIG. **8**, the execution screen of the benchmarking program illustrates a result display region with respect to a Music & Video Pattern, a Camera Pattern, a Camcorder Pattern, an Internet Pattern, and a Maps Pattern. FIG. **9** illustrates a result display region with respect to a Write 1 MB file, a Read 1 MB file, a Copy 1 MB file, Write 10 KB*100 files, Read 10 KB*100 files, Copy 10 KB*100 files, a Music & Video Pattern, a Camera Pattern, a Camcorder Pattern, an Internet Pattern, and a Maps Pattern. The representative time of applications in which benchmarking tests are performed is displayed on the result display region. After performing the benchmarking tests, the test performing unit **163** controls the display unit **150** to display a benchmarking test result screen illustrated in FIG. **8** or FIG. **9**.

[0089] FIG. **10** is a view illustrating an example of an execution screen of a benchmarking program according to an exemplary embodiment of the present invention.

[0090] Referring to FIG. **10**, the screen of the benchmarking program displays a test result score of the mobile terminal **100**.

[0091] The test result score is displayed as a ‘Test Result Score: 10.0’ of the mobile terminal **100** and a confirm key is displayed with ‘OK’. A user may confirm performance of the mobile terminal **100** using a screen illustrated in FIG. **10**. Further, the user may objectively compare performance of the mobile terminal with each other by confirming performance scores by mobile terminals.

[0092] While the invention has been shown and described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims and their equivalents.

What is claimed is:

1. A method for evaluating performance of a mobile terminal, the method comprising:

executing applications of a preset list;

extracting storage approach patterns for the executed applications;

generating test scenarios for the executed applications using the extracted storage approach patterns;

performing benchmarking tests for the applications using the generated test scenarios; and

evaluating the mobile terminal based on results of the performed benchmarking tests.

2. The method of claim **1**, wherein the extracting of the storage approach patterns comprises extracting the storage approach patterns for the executed applications including a current time after booting the mobile terminal, an Elapsed Time of operation, a type (Read/Write) of the operation, a Start Sector which an Input/Output (I/O) Request approaches, and a Sector Size.

3. The method of claim **2**, wherein the generating of the test scenarios comprises generating the test scenarios for the executed applications including a Text ID, the Start Sector, the Sector Size, the type (Read/Write) of the operation, a Delay Time with a next test, and an application name.

4. The method of claim **3**, wherein the performing of the benchmarking tests comprises:

performing benchmarking tests for the applications of the preset list;

measuring test performing times for applications for preset times;

determining an average value of the measured test performance times for applications; and

determining the determined average value as representative time of a corresponding application.

5. The method of claim **4**, wherein the evaluating of the mobile terminal comprises:

verifying weights allotted by applications for which the benchmarking tests are performed;

applying the weights by the applications to the determined representative times of the applications, respectively;

determining an average value of the representative times of the applications to which the weights are respectively applied; and

evaluating a score corresponding to the determined average value as the performance of the mobile terminal.

6. The method of claim **4**, further comprising separately displaying the determined representative times of the applications by the applications.

7. The method of claim **1**, wherein the executing of the applications comprises executing the applications of the preset list when an execution command for a benchmarking program installed in the mobile terminal is input.

8. The method of claim **1**, wherein the executing of the applications comprises executing at least one of an Internet web browser application, a map searching application, a music and video playing application, a photographing application, and a moving image photographing application.

9. A mobile terminal comprising:

a storage unit for storing at least one application and benchmarking program;

an approach pattern extracting unit for extracting storage approach patterns by executed applications;

an approach pattern analyzing unit for generating test scenarios for the executed applications using the extracted storage approach patterns;

a test performing unit for performing benchmarking tests by applications using the generated test scenarios; and

a performance evaluating unit for evaluating performance of the mobile terminal using results of the performed benchmarking tests.

10. The mobile terminal of claim **9**, wherein the storage unit stores the extracted approach patterns and the generated test scenarios.

11. The mobile terminal of claim **9**, wherein the approach pattern extracting unit extracts storage approach patterns including a current time after booting the mobile terminal, an Elapsed Time of operation, a type (Read/Write) of the operation, a Start Sector in which an input/output (I/O) Request approaches, and a Sector Size for the executed applications.

12. The mobile terminal of claim **11**, wherein the approach pattern analyzing unit generates test scenarios by the executed applications including a Text IDentification (ID), the Start Sector, the Sector Size, the type (Read/Write) of the operation, a Delay Time with a next test, and an application name.

13. The mobile terminal of claim **12**, wherein the test performing unit performs benchmarking tests for the applications of the preset list, measures test performing times by applications preset times, determines an average value of the measured test performing times by applications, and determines the determined average value as representative time of a corresponding application.

14. The mobile terminal of claim **13**, wherein the performance evaluating unit verifies weights allotted by applications for which the benchmarking tests are performed, applies weights by the applications to the determined representative times of applications, respectively, determines an average value of the representative times of the applications to which the weights are respectively applied, and evaluates a score corresponding to the determined average value as the performance of the mobile terminal.

15. The mobile terminal of claim **13**, further comprising a display unit for separately displaying the determined representative times of the applications by the applications.

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