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(54) METHOD OF MONITORING A TASK FOR AN ELECTRONIC MODULE

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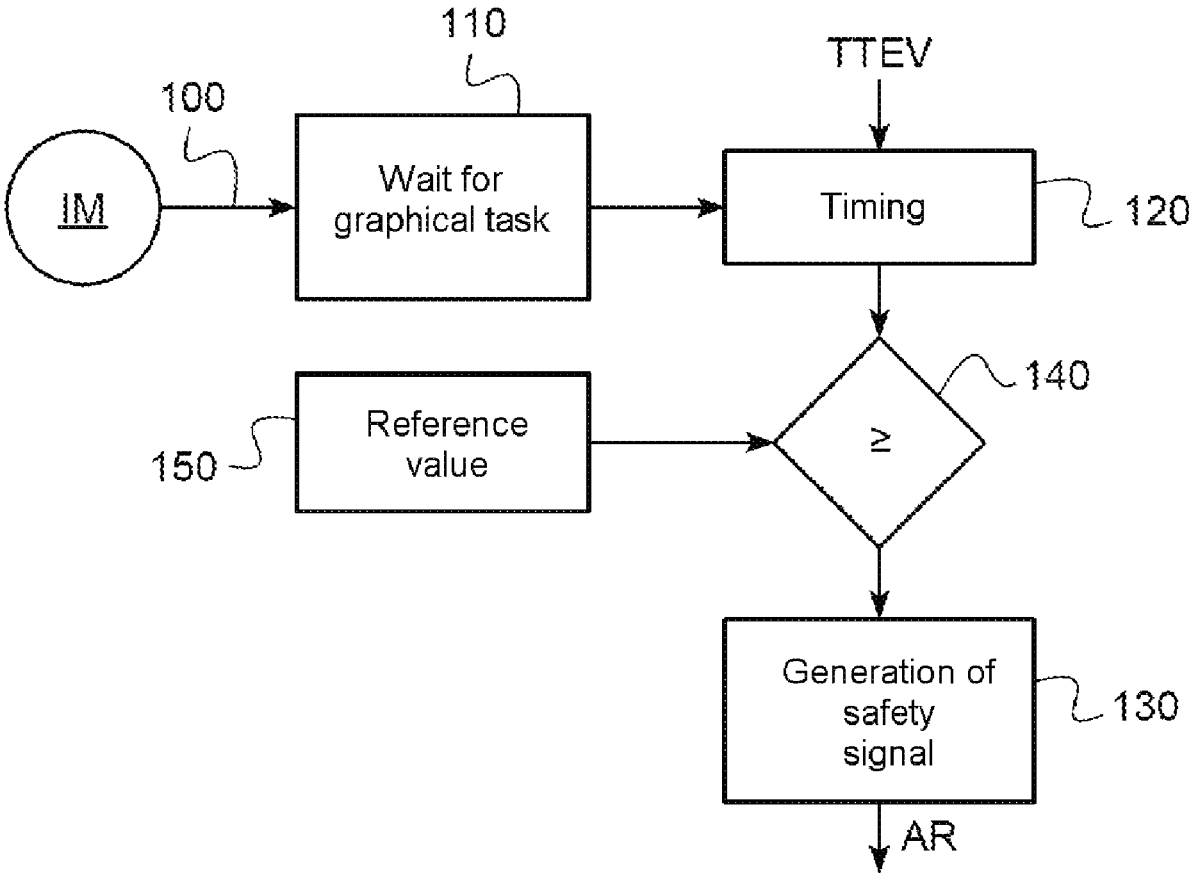
(57) **ABSTRACT**

A method can be used monitoring a task for an electronic module. The method includes waiting for performance of the task, timing the wait, the timing being regulated by a clock signal and generating an alert signal when the timing of the wait has exceeded a reference value. The device can be part of a multimedia interface (e.g., a display) electronic module and the task a graphical task (e.g., an image refresh).



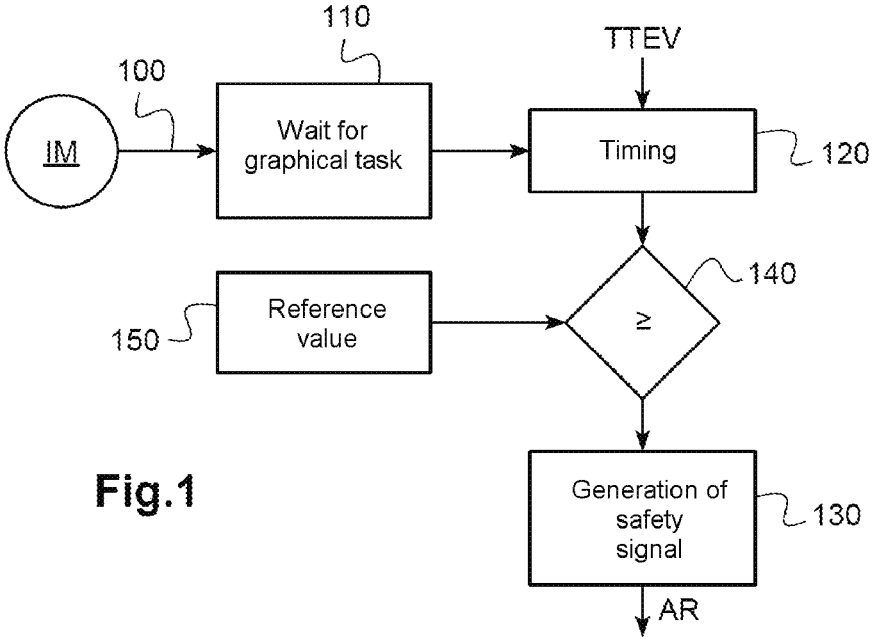

110
TTEV
100
IM
Wait for graphical task
Timing
120
140
150
Reference value
≥
Generation of safety signal
130
AR

Fig.1

Fig.2

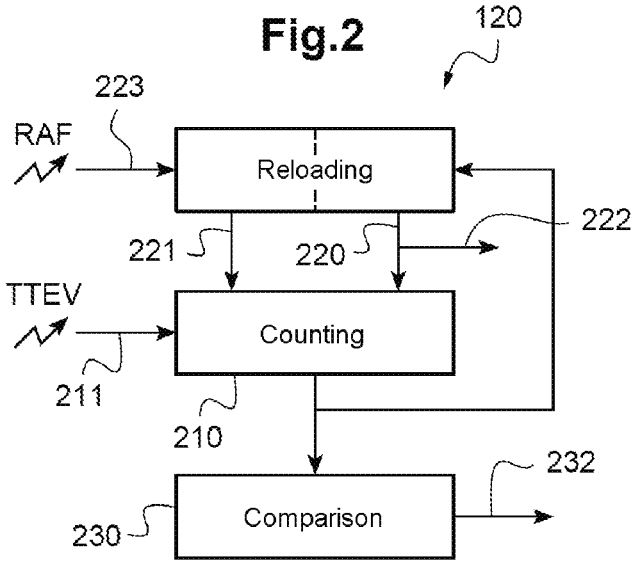

120
223
RAF
Reloading
222
221
220
TTEV
Counting
211
210
232
230
Comparison

Fig.3

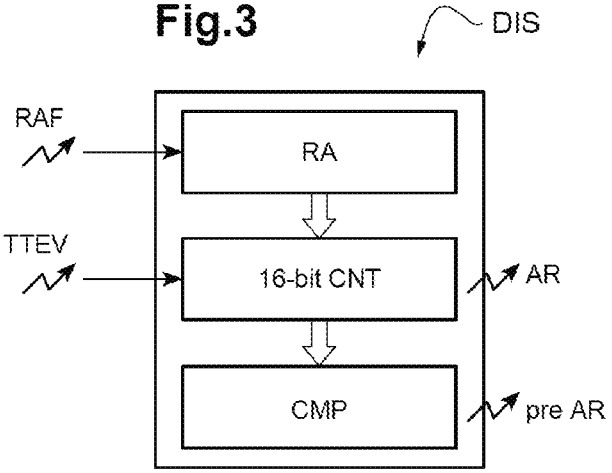


Fig.4

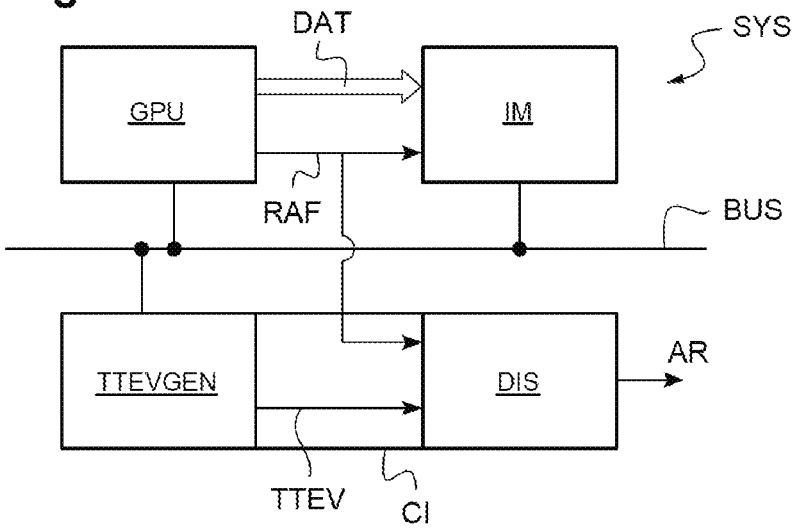
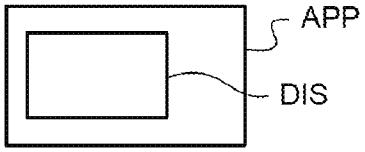


Fig.5



METHOD OF MONITORING A TASK FOR AN ELECTRONIC MODULE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to French Patent Application No. 1860187, filed on Nov. 6, 2018, which application is hereby incorporated herein by reference.

TECHNICAL FIELD

[0002] Modes of implementation and embodiments relate to a method monitoring a task for an electronic module.

BACKGROUND

[0003] Devices for monitoring a task for an electronic module are commonly referred to by the person skilled in the art by the expression "Watchdog."

[0004] Electronic modules of the multimedia interface type, in particular OLED ("Organic Light-Emitting Diode") displays, or else active matrix OLED displays, usually referred to by the acronym AMOLED standing for "Active Matrix OLED," are advantageous in numerous regards and are increasingly being used in all forms of application.

[0005] A drawback, which is almost exclusive, of this type of display is its lifetime. Indeed, OLED displays deteriorate when they display a static signal for too long, in particular, a white light static signal.

[0006] Of course, other types of electronic modules may also deteriorate in case of absence of performing of a task, for example, in the case of an electronic module controlled by an ancillary element which might not be perfectly adapted or configured for this electronic module. Indeed, it may be tricky for a non-expert user to alleviate by anticipation any risky situation in the use of the electronic module.

SUMMARY

[0007] Modes of implementation and embodiments relate to the monitoring of a task for an electronic module. Particular embodiments relate to a graphical task for a multimedia interface module of the OLED display type.

[0008] Embodiments can protect electronic modules in their usage, for example, with regard to degradation due to an absence of performing of a task.

[0009] According to one aspect, a method can be used for monitoring a task for an electronic module. The method comprises a wait for a performing of the task, a timing of the wait regulated by a clock signal, and a generation of at least one alert signal if the timing of the wait has exceeded a reference value.

[0010] The clock signal and the reference value are advantageously configured jointly in such a way as to protect the usage of the electronic module, and in conjunction with the task.

[0011] According to one mode of implementation, the timing of the wait comprises a counting with automatic reloading comprising an incrementation or a decrementation regulated by the clock signal, and an automatic reinitialization of the value of the counting to a starting value when the value of the counting reaches an end value, and a generation of an end signal at each automatic reinitialization, the at least one generation comprising the generation of the end signal forming the alert signal.

[0012] For example, the counting with automatic reloading comprises a reinitialization of the value of the counting to the starting value, without generating the end signal, on command of a forced reload signal, and in which a signal representative of the performing of the task is used as forced reload signal.

[0013] This mode of implementation exhibits the advantage of being simple and reliable, in particular since customary signals for multimedia interface control are used, without implementing an analysis that might be complex and prone to malfunctions.

[0014] Advantageously, the method furthermore comprises a comparison of the value of the counting with at least one other reference value, the at least one generation comprising a generation of a preliminary alert signal when the value of the count equals the at least one other reference value.

[0015] This affords the possibility of having additional alert signals at lower cost.

[0016] The monitoring method may be dedicated to a multimedia interface electronic module such as a display, and the task is a graphical task, such as an image refresh.

[0017] According to one mode of implementation, the clock signal corresponds to a counting of a given quantity of image frames processed by the multimedia interface module.

[0018] Such a clock signal may advantageously be a trigger signal formulated using a method described in the French Patent Application No. 1860188, titled "Procédé d'élaboration de signaux déclencheurs pour une commande d'une interface multimédia, et circuit intégré correspondant" [Method for formulating trigger signals for control of a multimedia interface, and corresponding integrated circuit], filed in the name of the applicant on the same day as the priority application of the present patent application. This French patent application is hereby incorporated herein by reference, as is the U.S. counterpart application entitled Method of Producing Triggering Signals for Control of a Multimedia Interface, which is being filed concurrently herewith.

[0019] That said, the clock signal may also originate from some other source, such as a control unit of the multimedia interface module. Generally, the clock signal and the reference duration are configured jointly in such a way as to protect the usage of the multimedia interface module in conjunction with the graphical task; this mode of implementation is an advantageous example for the joint configuration, using a signal directly representative of the usage of the multimedia interface module in conjunction with the graphical task.

[0020] According to one mode of implementation, the performing of the graphical task comprises a communication to the multimedia interface module of an image refresh signal.

[0021] According to one mode of implementation, the multimedia interface module is an organic light-emitting diode-based display module.

[0022] Advantageously, the reference value corresponds to a duration beyond which there is a risk of damage, at least in part, to the organic light-emitting diode-based display module displaying a static signal.

[0023] The method according to these modes of implementation makes it possible to solve in particular the above-

mentioned drawback of degradation of OLED displays when they display a static signal for too long.

[0024] According to another aspect, there is proposed a device for monitoring a task for an electronic module, comprising a timer configured to wait for a performing of the task and time the wait in a manner regulated by a clock signal, and configured to generate at least one alert signal if the timing of the wait has exceeded at least one reference value.

[0025] According to one embodiment, the timer comprises a counter with automatic reloading configured to increment or decrement a value of the counter in a manner regulated by the clock signal, and, when the value of the counter reaches an end value, automatically reinitialize the value of the counter to a starting value and generate an end signal, the end signal forming the safety signal.

[0026] For example, the counter is furthermore configured to reload the value of the counter to the starting value, without generating the end signal, on command of a forced reload signal, and in which a signal representative of the performing of the task is used as forced reload signal.

[0027] Advantageously, the device furthermore comprises a comparator configured to compare the value of the counter with at least one other reference value, and to generate respectively at least one preliminary alert signal when the value of the counter equals the at least one other reference value.

[0028] The device may be dedicated to a multimedia interface electronic module such as a display, and the task is a graphical task, such as an image refresh

[0029] According to one embodiment, the device comprises a device for generating trigger signals, configured to generate the clock signal corresponding to a counting of a given quantity of image frames displayed by the multimedia interface.

[0030] According to one embodiment, the timer is configured to wait for a performing of the graphical task comprising a communication of an image refresh signal to the multimedia interface module, by an external control module of the multimedia interface.

[0031] According to one embodiment, the device is dedicated to a multimedia interface module of the organic light-emitting diode-based display module type.

[0032] Advantageously, the at least one reference value corresponds to a duration beyond which there is a risk of damage, at least in part, to the organic light-emitting diode-based display module displaying a static signal.

[0033] There is also proposed an integrated circuit comprising a device such as defined hereinabove, as well as an electronic apparatus, such as a mobile telephone or a smartwatch, comprising the integrated circuit or a device such as defined hereinabove.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] Other advantages and characteristics of the invention will become apparent on examining the detailed description of wholly non-limiting embodiments and modes of implementation, and the appended drawings in which:

[0035] FIGS. **1** and **2** schematically illustrate various modes of implementation of the invention;

[0036] FIGS. **3** to **5** schematically illustrate various embodiments of the invention.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0037] FIG. **1** illustrates a method for monitoring a task **100** for an electronic module IM, comprising a wait for a performing of the task **110**, a timing of the wait **120** regulated by a clock signal TTEV, and at least one generation **130** of an alert signal AR if the timing of the wait has exceeded **140** a reference value **150**.

[0038] FIG. **1** refers to a particular case of multimedia interface electronic module, such as a display and preferably of the organic light-emitting diode "OLED" display type, the monitored task being a graphical task.

[0039] The method is earmarked to be implemented by an integrated circuit device.

[0040] The method comprises a wait **110** for a performing of the graphical task **100** and a timing of the wait **120**, regulated by a clock signal TTEV.

[0041] The performing of the graphical task **100** can comprise a communication to the multimedia interface module IM of an image refresh signal.

[0042] The image refresh signal, for example transmitted to the multimedia interface module IM from an external control element, may for example be a specific signal arising from a software instruction, or be generated automatically each time the control element gives an image refresh instruction. An image refresh instruction, within the framework of a module of the display type, typically comprises new graphical data to be displayed.

[0043] The current value of the timing **120** is compared **140** with at least one reference value **150**. If the current value of the timing **120** is greater than or equal to the reference value, at least one respective alert signal AR is generated **130**.

[0044] Stated otherwise, an alert signal AR is generated **130** if the timing of the wait has exceeded **140** a reference value **150**.

[0045] For example, the clock signal TTEV corresponds to a counting of a given quantity of image frames processed by the multimedia interface module IM.

[0046] For a display multimedia interface module IM, by "quantity of image frames processed" is meant the quantity of frames displayed at the display's refresh frequency, defined by the number of images that can be displayed per second, otherwise referred to as vertical scan frequency.

[0047] The distinction must be made between the frequency of refreshing of the display (vertical scan), which is an intrinsic characteristic of the multimedia interface module, and the image refresh signal, which is a control signal typically accompanied by graphical data originating for example from an external control element.

[0048] Stated otherwise, by image refresh signal is meant a signal introducing variations into the displayed signal, while the quantity of image frames processed at the refresh frequency may comprise successive identical frames, that is to say the display of a static signal.

[0049] Thus, the clock signal TTEV, corresponding to a counting of a given quantity of image frames processed by the multimedia interface module IM, may be representative of a display of a static signal.

[0050] In the example of a module of the OLED display type, this mode of implementation makes it possible to protect the display from premature wear.

[0051] In this regard, the reference value **150** is determined so as to correspond to a duration beyond which there is a risk of damage to the OLED display module displaying a static signal.

[0052] Of course, the reference value, counted on the clock signal TTEV, is established by taking account of the hardware limits of the OLED display module used.

[0053] Thus, the reference value and the clock signal are both programmable, in order to configure them jointly so as to protect the usage of a given multimedia interface module in conjunction with a given graphical task.

[0054] For its programming, the reference value may for example be a variable recorded in a register.

[0055] For its programming, the clock signal TTEV may be an external shared clock signal, or preferably be a dedicated signal generated by a microcontroller, or more preferably be a synchronization signal possibly transmitted by the multimedia interface module, or still more preferably be a trigger signal formulated by a method or an integrated circuit such as taught in the French patent application 1860188 entitled "Procédé d'élaboration de signaux déclencheurs pour une commande d'une interface multimédia, et circuit intégré correspondant" [Method for formulating trigger signals for control of a multimedia interface, and corresponding integrated circuit], filed by the applicant on the same day as the priority application of the present patent application.

[0056] Indeed, the above-mentioned method for formulating trigger signals for control of a multimedia interface and the corresponding integrated circuit make it possible to generate flexible and adaptable trigger signals TTEV, and thus to generate a clock signal perfectly configured to protect the usage of a given multimedia interface module in conjunction with a given graphical task.

[0057] Moreover, the method is advantageously implemented distinctly from the multimedia interface control operations (generally done by a microcontroller). Thus, the method makes it possible to protect the display in case of malfunctioning of the control operations, even in the eventuality that the latter were to comprise a comparable preventive measure.

[0058] FIG. **2** represents an exemplary mode of implementation of timing **120** of a method such as described in conjunction with FIG. **1**.

[0059] In this example, the method comprises, in order to time the wait **120**, a counting with automatic reloading **210** regulated by a signal **211** of the clock signal type. The clock signal TTEV is used directly to regulate **211** the counter **210**.

[0060] It is immaterial whether the counting **210** be an ascending counting, comprising an incrementation at each rising edge of the clock signal TTEV, or a descending counting, comprising a decrementation at each rising edge of the clock signal TTEV.

[0061] The value of the counting is automatically reinitialized **220** to a starting value (usually zero for an ascending counting and a programmable value for a descending counting) when the value of the counting reaches an end value (usually a programmable value for an ascending counting and zero for a descending counting).

[0062] When the value of the counting reaches the end value, an end signal **222** is generated.

[0063] Thus, the programmable starting value (for a descending counting) or end value (for an ascending counting) is established in such a way that the end of the counting is representative of a reference duration (reference value), as a function of the clock signal TTEV.

[0064] The reference value corresponds to a duration beyond which the absence of graphical task is problematic.

[0065] Thus, the end signal **222** may form the alert signal AR directly.

[0066] Furthermore, the counting **210** with automatic reloading comprises a reinitialization **221** of the value of the count to the starting value, without generating the end signal **222**, on command of a forced reload signal **223**.

[0067] Here, the signal RAF representative of the performing of the graphical task is used directly as forced reload signal **223**.

[0068] Thus, after the graphical task is performed, the value of the counting is reinitialized and the elapsing of the complete reference duration is awaited before the alert signal AR is generated.

[0069] The method may comprise a comparison **230** of the value of the counting with at least one other reference value, possibly likewise programmable and stored in a register.

[0070] If the value of the counting **210** equals the at least one other reference value **150**, then a respective preliminary alert signal **232** is generated.

[0071] The alert signals **222**, **232**, preliminary or not, may allow a command of the multimedia interface to engage protection measures.

[0072] For example, in the case mentioned hereinabove of a forestalling of static display on an OLED display, the command may make provision for a standby mode which displays a moving image, or for turning off the screen. Forced shutdown of the screen may also be provided for as a last resort, this being advantageous for example in a case of malfunction of the command.

[0073] FIG. **3** illustrates a particular example of a device DIS for monitoring a task of an electronic module.

[0074] The monitoring device DIS is configured to wait for a performing of the task, time the wait in a manner regulated by at least one clock signal TTEV, and generate at least one safety signal AR if the timing of the wait has exceeded at least one reference value.

[0075] Likewise, FIG. **3** refers to a particular example in which the electronic module is a multimedia interface, such as a display and preferably an organic light-emitting diode OLED display, the monitored task being a graphical task.

[0076] The monitoring device DIS comprises a counter CNT, for example on 16 bits with automatic reloading RA. The value of the counter CNT is incremented or decremented in a manner regulated by a clock signal TTEV.

[0077] Hereinafter, the example of a down counter will be considered, the value of which is decremented by the clock signal TTEV. This example is not limiting.

[0078] The starting value of the counter is loaded automatically from an automatic reload register RA. When the value of the counter is decremented down to an end value, usually zero, the starting value is reinitialized automatically, and an end-of-decrementation signal AR is generated. Here, the end-of-decrementation signal is used directly as safety signal AR.

[0079] Nonetheless, a forced reload signal may make it possible to command a reinitialization of the value of the counter CNT to its starting value before reaching zero, without generating the end-of-decrementation signal AR. The signal RAF representative of the performing of the graphical task is used directly as forced reload signal.

[0080] The monitoring device DIS may comprise a comparator CMP configured to compare the current value of the counter CNT with at least one reference value recorded in a register. When the value of the counter reaches the at least one reference value, at least one respective preliminary alert signal preAR is generated so as to signal the approach of a dangerous situation.

[0081] The monitoring device DIS is most particularly adapted to a multimedia interface module of the OLED organic light-emitting diode-based display type.

[0082] Indeed, an absence of refreshing of the display for too long a duration may irreversibly damage the OLED display interface.

[0083] Thus, the event resulting from the graphical task may advantageously comprise a signal RAF representative of a refreshing of the image.

[0084] FIG. **4** illustrates an exemplary application of a device DIS such as described hereinabove in conjunction with FIG. **3**, in a system comprising an integrated circuit CI comprising the device DIS, the multimedia interface module IM, and a control unit GPU of the multimedia interface IM. The various elements are in particular linked by a data bus BUS.

[0085] In this example, the multimedia interface module IM is an OLED organic light-emitting diode-based display module, and the device DIS is dedicated to a multimedia interface module IM of the OLED organic light-emitting diode-based display module type.

[0086] In this example, the integrated circuit CI comprising the device DIS furthermore comprises a device for generating trigger signals TTEVGEN, configured to generate the clock signal TTEV.

[0087] The clock signal TTEV corresponds for example to a counting of a given quantity of image frames displayed by the multimedia interface IM, such as described in the French Patent Application No. 1860188, titled "Procédé d'élaboration de signaux déclencheurs pour une commande d'une interface multimédia, et circuit intégré correspondant" [Method for formulating trigger signals for control of a multimedia interface, and corresponding integrated circuit], filed by the applicant on the same day as the priority application of the present patent application.

[0088] Here also, by image refresh signal is meant a signal introducing variations into the displayed signal, while the quantity of image frames processed at the refresh frequency may comprise successive identical frames, that is to say the display of a static signal.

[0089] In the system SYS, the control unit GPU can communicate image data DAT to the multimedia interface module IM, as well as control signals, such as an image refresh signal RAF. The image refresh signal RAF communicated by the control unit GPU controls the display of new image data replacing old image data.

[0090] In this example, the device DIS is configured to wait, in the guise of the graphical task, for a communication of the image refresh signal RAF to the multimedia interface module IM, by a control module of the multimedia interface GPU.

[0091] The device DIS is configured to generate the alert signal AR if no image refresh RAF is communicated for a duration beyond which there is a risk of damage, at least in part, to the OLED organic light-emitting diode-based display module displaying a static signal.

[0092] FIG. **5** illustrates schematically an electronic apparatus, such as a mobile telephone or a smartwatch, comprising a device DIS such as described previously in conjunction with FIG. **3** or **4**, possibly incorporated into an integrated circuit CI.

[0093] Moreover the invention is not limited to these embodiments and modes of implementation but embraces all variants thereof; it is recalled in particular that the monitoring of a task can apply to an electronic module of a type other than an OLED display, the monitored task being able likewise to be of a different nature.

What is claimed is:

1. A method of monitoring a task for an electronic module, the method comprising:
- waiting for performance of the task;
- timing the wait, the timing being regulated by a clock signal; and
- generating an alert signal when the timing of the wait has exceeded a reference value.

2. The method according to claim **1**, wherein timing the wait comprises:
- counting with automatic reloading comprising an incrementation or a decrementation regulated by the clock signal;
- automatically reinitializing the counting to a starting value when the value of the counting reaches an end value; and
- generating an end signal at each automatic reinitialization, the end signal forming the alert signal.

3. The method according to claim **2**, wherein the counting comprises reinitializing the value of the counting to the starting value, without generating the end signal, on command of a forced reload signal, and wherein a signal representative of performing the task is used as the forced reload signal.

4. The method according to claim **2**, further comprising comparing the value of the counting with another reference value, wherein generating the end signal comprises generating a preliminary alert signal when the value of the counting equals the other reference value.

5. A method of monitoring a graphical task for a multimedia interface module, the method comprising:
- waiting for performance of the task;
- timing the wait, the timing being regulated by a clock signal; and
- generating an alert signal when the timing of the wait has exceeded a reference value.

6. The method according to claim **5**, wherein the method is performed with a display and wherein the task is an image refresh.

7. The method according to claim **5**, wherein the clock signal corresponds to counting of a given quantity of image frames processed by the multimedia interface module.

8. The method according to claim **5**, wherein performing the graphical task comprises communicating an image refresh signal to the multimedia interface module.

9. The method according to claim **5**, wherein the multimedia interface module is an organic light-emitting diode (OLED)-based display module.

10. The method according to claim **9**, wherein the reference value corresponds to a duration beyond which there is a risk of damage, at least in part, to the organic light-emitting diode (OLED)-based display module displaying a static signal.

11. A device for monitoring a task for an electronic module, the device comprising:

a timer configured to wait for performance of the task and to time the wait in a manner regulated by a clock signal, and

a signal generator configured to generate an alert signal when the time of the wait has exceeded at least one reference value.

12. The device according to claim **11**, wherein the timer comprises a counter with automatic reloading configured to increment or decrement a value of the counter in a manner regulated by the clock signal, and, when the value of the counter reaches an end value, to automatically reinitialize the value of the counter to a starting value and to generate an end signal, the end signal forming the alert signal.

13. The device according to claim **12**, wherein the counter is further configured to reload the value of the counter to the starting value, without generating the end signal, on command of a forced reload signal, and wherein a signal representative of the performance of the task is used as the forced reload signal.

14. The device according to claim **12**, further comprising a comparator configured to compare the value of the counter with at another reference value, and to generate a preliminary alert signal when the value of the counter equals the other reference value.

15. The device according to claim ii, wherein the device is part of a multimedia interface electronic module and wherein the task is a graphical task.

16. The device according to claim **15**, wherein the device is part of a display and wherein the task is an image refresh.

17. The device according to claim **15**, further comprising trigger signal generator configured to generate the clock signal corresponding to a counting of a given quantity of image frames displayed by a multimedia interface of the multimedia interface electronic module.

18. The device according to claim **15**, wherein the timer is configured to wait for the performance of the graphical task that comprises communication of an image refresh signal to the multimedia interface electronic module, by an external control module of a multimedia interface of the multimedia interface electronic module.

19. The device according to claim **15**, wherein the device is part of a multimedia interface module of an organic light-emitting diode (OLED)-based display module type.

20. The device according to claim **19**, wherein the reference value corresponds to a duration beyond which there is a risk of damage, at least in part, to the organic light-emitting diode (OLED)-based display module displaying a static signal.

* * * * *