

MOBILE DEVICE

Field of the invention

The present invention relates to a mobile device and a software architecture for use in a mobile device. In particular, the present invention relates to a mobile device having reduced hardware and software requirements in the operation of the mobile device.

Background of the invention

There has been a rapid growth in the number and use of mobile cellular telephones. More recently, wireless devices have been introduced which combine the functionality of mobile phone and Personal Digital Assistants (PDAs). It is expected that this area will undergo further growth in the near future as new cellular telecommunication standards make it possible for high speed transfer of data across the wireless interface.

Mobile devices such as smart phones are becoming capable of performing a large number of functions. These mobile devices tend to be loaded with a large number of software applications for performing these different functions.

Smart phones are devices that are able to handle computing and communication needs in a single small package. Smart phones may be thought of as handheld computers integrated with a mobile telephone, and usually allow the user to install and run advanced applications. Unlike traditional mobile phones, smart phones allow individual users to install, configure and run applications of their choosing. A smart phone offers the ability to conform the device to a user's particular way of doing things and allows the user to make voice/video calls, email, download and access applications such as word processing programs or video games. In addition, it may also allow a user the option of playing audio and video files in some standard formats. A difficulty arises in making these mobile devices lighter, smaller and cheaper to manufacture yet retaining their ability to perform all the desired applications.

Current smart phones require multiple micro-controller units (MCUs) in order to perform the functions listed above. Each MCU may contain one or more computer processors necessary to run or control the relevant operating system to manage the hardware components of the mobile device. Each MCU has its own peripheral components (e.g. Flash, RAM and etc.) to support an operating system. As such, at present, a number of processors are required to provide the necessary control of the many hardware components of the mobile device. For example, a typical smart phone requires two MCUs, each MCU running its own operating system independently. In particular, at present, there must be at least two computer processors required for the optimum operation of a typical smart phone. One processor is required to solely manage and operate the modem, while another processor is required to manage and operate the other applications of the smart phone. One processor is dedicated to the operation of the modem because of the complex operation of the modem. Also, the processor operating the modem cannot then operate the other applications of the smart phone.

There has been an attempt in reducing the size and number of MCUs in a smart phone. For example, one approach is to integrate two MCUs onto a single chip. However, while this lowers of the cost of manufacturing the chip, the system complexities remain. For example, integrating two MCUs onto a single chip means packing two or more computer processors onto a single chip. The size of a single MCU is limited and, therefore, the challenge lies in packing too many components onto a limited-sized chip. Also, additional control modules and data communication modules are required to integrate two MCUs onto a single chip.

In another approach, a “virtual machine” is set up to simulate two MCUs for running the operating system. A “virtual machine” is a software implementation of a machine that executes programs like a physical machine. This approach allows for one MCU to simulate two or more MCUs. However, the problem with such a “virtual machine” is that the hardware (e.g. RAM) and power requirements for the MCU are very high.

Summary of the invention

In accordance with a first aspect of the invention, there is provided a mobile device comprising: a single computer processor capable of operating a modem, wherein said

processor is also capable of receiving instructions from at least two operating systems, and at least one of the two operating systems provides instructions to the computer processor to operate the modem. Advantageously, only a single modem is required for the mobile device and this single modem resides on the single processor. The single processor is able to process all the functions of the mobile device.

Preferably, the computer processor is capable of receiving instructions from two operating systems, a first operating system stacked below a second operating system in a stacked software architecture.

Preferably, the first operating system provides instructions to the computer processor to operate the modem, the first operating system is a real-time operating system.

Preferably, the second operating system provides instructions to the computer processor to operate at least one application program, the second operating system is a run-time operating system.

Preferably, the at least one application programme is selected from the group comprising: an email application programme, an internet browser application programme, a telephone book application programme, and a message application programme.

Preferably, communication between the first operating system and the second operating system takes place over an application program interface.

Preferably, the computer processor resides on a single micro-controller unit.

Preferably, the mobile device is a mobile phone or a personal digital assistant device with mobile communications functionality.

In accordance with a second aspect of the invention, there is provided a software architecture for use in a mobile device, the software architecture comprising: a single computer processor capable of operating a modem, wherein said processor is also capable of receiving instructions from at least two operating systems, and at least one of

the two operating systems provides instructions to the computer processor to operate the modem.

Preferably, the computer processor is capable of receiving instructions from two operating systems, a first operating system stacked below a second operating system in a stacked software architecture.

Preferably, the first operating system provides instructions to the computer processor to operate the modem, the first operating system is a real-time operating system.

Preferably, the second operating system provides instructions to the computer processor to operate at least one application program, the second operating system is a run-time operating system.

Brief description of figures

In order that the present invention may be fully understood and readily put into practical effect, there shall now be described by way of non-limitative examples only preferred embodiments of the present invention, the description being with reference to the accompanying illustrative figures.

In the Figure:

Figure 1 shows a schematic diagram of an operating software architecture according to an embodiment of the present invention; and

Figure 2 shows a schematic diagram of an operating software architecture according to another embodiment of the present invention.

Detailed description of the preferred embodiments

Referring to Figure 1, there is provided a software architecture 2 for use in a mobile device. For example, the mobile device may be selected from the group including, but not

limited to, a mobile personal computer, a netbook, a mobile telephone, a laptop computer, a handheld computer and a smart phone.

The software architecture 2 in Figure 1 is a stacked software architecture. In particular, two operating systems are stacked on each other. By “operating system”, it is meant to include any software comprising of programmes and data that is able to run on a computer processor and manages the mobile device hardware resources and provides common services for execution of various application software used by the mobile device. The operating system may also act as an intermediary between application programs and the hardware found on the mobile device.

In the present invention, a first operating system 4 is stacked below a second operating system 6. In an exemplary example, the first operating system 4 may be a real-time operating system and the second operating system 6 may be a runtime operating system. By “real-time operating system”, it is meant to include any operating system that is a multitasking operating system and aims at executing real-time applications. By “runtime operating system” (also called runtime system or just runtime), it is meant to include any software designed to support the execution of computer programs written in some computer language. Run-time operating system contains implementations of basic low-level commands and may also implement higher-level commands and may support type checking, debugging, and even code generation and optimisation.

The stacked software architecture 2 provides instructions to a single computer processor that is capable of operating a modem. The modem resides on this computer processor. In the present invention, the first operating system 4 provides instructions to the computer processor to operate the modem while the second operating system 6 provides instructions to the computer processor to operate at least one application program. Typically, the application programme includes any application programme that may be used on a smart phone. Examples include an email application programme, an internet browser application programme, a telephone book application programme, and a message application programme.

Figure 2 shows the stacked architecture 2 when in use in a mobile device environment 10. In addition to providing instructions to operate the modem, the first operating

system 4 is also configured to operate other hardware components and/or drivers. For example, It is responsible to provide hardware abstract layer (firmware/driver) support and handle all the hardware related service, the component which it can support are including: LCD, SIM, Battery, GSM Time Unit, RF Micro, DSP module, Audio, GPS/AGPS, BlueTooth, Keypad, RAM, FLASH, SPI, UART, USB, SD and other peripherals.

The second operating system 6 exists on kernel 35. In this OS, all the user interface applications are in this layer. For example, graphics service, multimedia service, network related service, message Service, file Service and so on. Drivers are not included in this kernel 35. The second operating system 6 is responsible for all these user interface applications.

The first operating system 4 and the second operating system 6 takes place using an application program interface (API) 40. The first operating system 4 and second operating system 6 are independent from each other, and co-exist with respect to the other. Each operating system is a fully functioning operating system environment, and does not need the other operating system environment to function. The two operating system environments exist on the same mobile device with 100% independence with respect to each other. The second operating system 6 is designed for an upper layer, so it needs to sit on top of the first operating system 4. In the present invention, the first operating system 4 is a real-time operating system and the second operating system 6 is a runtime operating system. If there is no real-time operating system support for the first operating system 4 (i.e. runtime operating system), either a special driver service layer should be adopted or some other operating system (e.g. Linux) may be used. The special driver service layer is to give a alternative option to provide basic Low level OS feature which is scheduling, tasking, interrupt handling, in another words, it is a simplified OS kernel .

The real-time operating system may be able to support certain applications that run on binary data. However, this pose as a limitation since there are more complex applications that are desired to be able to run on a smart phone. Also, another limitation of using the real-time operating system alone to support applications is that these applications cannot be changed – they are only able to be flashed once. Therefore, in the

present invention, the runtime operating system may act as an application that can be supported by the real-time operating system. In other words, the real-time operating system recognise the runtime operating system as an application. Therefore, a plurality of applications may be formed on the runtime operating system with communication between them taking place over an API.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made without departing from the present invention.

CLAIMS

1. A mobile device comprising:
a single computer processor capable of operating a modem,
wherein said processor is also capable of receiving instructions from at least two operating systems, and at least one of the two operating systems provides instructions to the computer processor to operate the modem.
2. The device according to claim 1, wherein the computer processor is capable of receiving instructions from two operating systems, a first operating system stacked below a second operating system in a stacked software architecture.
3. The device according to claim 2, wherein the first operating system provides instructions to the computer processor to operate the modem, the first operating system is a real-time operating system.
4. The device according to any one of claims 2 or 3, wherein the second operating system provides instructions to the computer processor to operate at least one application program, the second operating system is a run-time operating system.
5. The device according to claim 4, wherein the at least one application programme is selected from the group comprising: an email application programme, an internet browser application programme, a telephone book application programme, and a message application programme.
6. The device according to any one of claims 2 to 5, wherein communication between the first operating system and the second operating system takes place over an application program interface.
7. The device according to any one of the preceding claims, wherein the computer processor resides on a single micro-controller unit.

8. The device according to any one of the preceding claims, wherein the mobile device is a mobile phone or a personal digital assistant device with mobile communications functionality.

9. A software architecture for use in a mobile device, the software architecture comprising:

a single computer processor capable of operating a modem,
wherein said processor is also capable of receiving instructions from at least two operating systems, and at least one of the two operating systems provides instructions to the computer processor to operate the modem.

10. The software architecture according to claim 9, wherein the computer processor is capable of receiving instructions from two operating systems, a first operating system stacked below a second operating system in a stacked software architecture.

11. The software architecture according to claim 10, wherein the first operating system provides instructions to the computer processor to operate the modem, the first operating system is a real-time operating system.

12. The software architecture according to any one of claims 10 or 11, where the second operating system provides instructions to the computer processor to operate at least one application program, the second operating system is a run-time operating system.