

Enabling Multimedia Applications in Memory-Limited Mobile Devices

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INTRODUCTION

Embedded systems have several constraints which make the development of applications for such platforms a difficult task: memory, cost, power consumption, user interface, and much more. These characteristics restrict the variety of applications that can be developed for embedded systems. For example, storing and playing large videos with good resolution in a limited memory and processing power mobile device is not viable.

Usually, a client-server application is developed to share tasks: clients show results while servers process data. In such a context, another hard task for limited memory/processing devices could be delegated to the server: storage of large data. If the client needs data, it can be sent piece by piece from the server to the client.

In this article we propose a layered architecture that makes possible the visualization of large videos, and even other multimedia documents, in memory/processing limited devices. Storage of videos is performed at the server side, and the client plays the video without worrying about storage space in the device. Data available in the server is divided into small pieces of readable data for mobile devices, generally JPEG files. For example, when the client requests videos from the server, the videos are sent as JPEG files and shown at an ideal rate for users. The video frames are sent through a wireless connection.

The remainder of this article is organized as follows. We begin by describing background concepts on embedded systems and client-server applications, and then present our solution to enable multimedia applications in memory-limited mobile devices. We next discuss some future trends in mobile multimedia systems, and finally, present concluding remarks.

BACKGROUND

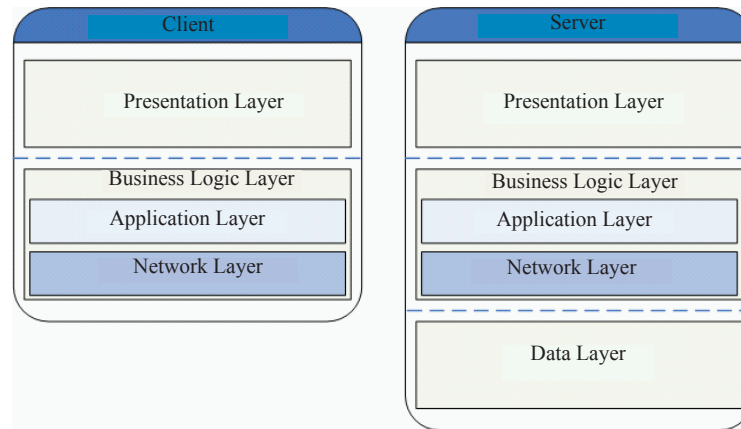
Embedded Systems

An embedded system is not intended to be a general-purpose computer. It is a device designed to perform specific tasks, including a programmable computer. A considerable number of products use embedded systems in their design: automobiles, personal digital assistants, and even household appliances (Wayne, 2005). These limited systems have some constraints that must be carefully analyzed while designing the applications for them: size, time constraints, power consumption, memory usage and disposal, and much more (Yaghmour, 2003).

These constraints restrict the variety of software for embedded systems. The development of applications which demand a large amount of memory, for example, is not viable for embedded systems, because the memory of such devices is limited. Extra memory can also be provided, but the total cost of application is very high. Another example is multimedia applications, such as video players: storing and playing large videos with good resolution in a limited memory and processing power mobile device is a very hard task.

There are specific platforms that were developed to perform multimedia tasks: embedded video decoders and embedded digital cameras, for example. However, other considerable parts of embedded systems, like personal digital assistants (PDAs) and cell phones, are not designed to play videos with good quality, store large amount of data, and encode/decode videos. Thus, it is important to design solutions enabling multimedia environments in this variety of memory/processing-limited devices.

Figure 1. Client/server architecture



Layered and Client-Server Architectures

Layered architectures share services through a hierarchical organization: each layer provides specific services to the layers above it and also acts as a client to the layer below (Shaw & Garlan, 1996). This characteristic increases the level of abstraction, allowing the partition of complex problems into a set of tasks easier to perform. Layered architectures also decouple modules of the software, so reuse is also more easily supported. As communication of layers is made through contracts specified as interfaces, the implementation of each module can be modified interchangeably (Bass & Kazman, 1998).

Most of the applications have three major layers with different functionalities: presentation, which handles inputs from devices and outputs to screen display; application or business logic, which has the main functionalities of the application; and data, which provides services for storing the data of the application (Fastie, 1999).

The client-server architecture has two elements that establish communication with each other: the front-end or client portion, which makes a service request to another program, called server; and the back-end or server portion, which provides service to the request. The client-server architecture allows an efficient way to interconnect programs that are distributed at different places (Jorwekar, 2005). However, the client-server architecture is more than just a separation of a user from a server computer (Fastie, 1999). Each portion has also its own modules: presentation, application, and data.

ENABLING MULTIMEDIA APPLICATIONS

Multimedia applications demand a considerable amount of resources from the environment in order to guarantee quality

of service, which can be defined in terms of security, availability, or efficiency (Banâtre, 2001). Embedded systems have several constraints, like limited memory (Yaghmour, 2003), which make it very difficult to implement multimedia applications in an embedded platform.

Today, the growing interest for mobile devices and multimedia products requires the development of multimedia applications for embedded systems (Banâtre, 2001). There are approaches (Grun, Balasa, & Dutt, 1998; Leeman et al., 2005) that try to enhance embedded systems memory and other system aspects, such as processing, to provide better results in multimedia applications. However, most of the solutions available focus on hardware architecture, and a large number of programmers are not used to programming at the hardware level.

A solution based on client-server architecture is a good proposal for limited-memory/processing mobile devices because harder tasks can be performed by the server side whereas the client just displays results. By designing applications based on an architecture that shares tasks, constraints like limited memory and low computing power are partially solved. In this article, we propose a layered, client/server architecture that allows playing and storing large videos on limited-memory/processing mobile devices. The data is sent through a wireless intranet.

Client/Server Architecture

In Figure 1, both client and server modules are illustrated. Each module of both elements can be changed at any time, except the application layer because the rules of application are defined on it: if business logic changes, so does the application.

The server architecture is a standard three-tier architecture:

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