Extending the podcasting approach: lectures on the phone

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Abstract: We explore the use of cellular phones as a mobile-learning resource. We extend the podcasting approach by including videos and images as a support for viewing traditional lectures, and by using devices that are already in the pocket of nearly every student.

1. Introduction

In the electronic age computers are pervasive: besides being present in their most recognizable form, such as personal and palmtop computers, they are embedded in many places, like in cars (in the form of satellite navigator, ABS and ESP systems etc.), in game devices, in automatic teller machines, and also in many appliances such a even fridges and washing machines. Almost every one of us carries in his pocket or in her purse a small device having more computing power than it was present on the machines that landed on the moon during the Apollo program: such powerful machines are disguised in the form cellular phones. Recent surveys (Thornton 2001, Trifonova 2006) run over more than 1000 students in three countries (Italy, Bulgaria and Japan) showed that every student owned (at least one) mobile telephone (while less than 20% of them had a PDA).

Most of today's cellular phones are real computing devices: they possess a true operating system (such as e.g. Symbian[1]) and can be programmed (e.g. by using Java Micro Edition[2]). The amount of available memory is significant, and they can store relatively large files. In the extreme case of the Apple iphone[3] the storage can presently reach 16 Gigabytes, and it is also possible to run a Unix shell on the device! Moreover, cellular phones have various forms of data connectivity, ranging from SMS to Bluetooth communication, to full Internet access via GPRS/EDGE/UMTS or via wi-fi connectivity.

It is therefore interesting to investigate how cellular phones can be used as mobile learning devices. Although the definition of mobile learning has a large scope, including both the mobility of the learner and/or mobile devices, we restrict it here to mean "the porting of e-learning application onto mobile devices".

Recently in the e-learning community there has been an explosion of interest in the podcasting technology that allows delivering of data streams, in most cases audio (MP3 files), even though devices like the Apple ipods[4] and compatible devices are (not yet) as ubiquitous as cellular phones. Moreover, only the most expensive versions of the ipod support also images and videos. Many of the mobile phones available on the market can also play MP3 streams, but in addition they embody a camera and they can record and reproduce images and videos. These facts motivated our work, in which we explored the possibility of deploying cellular phones as devices that extend the podcasting approach by using both audio and visual information.

In section 2 we examine the area of mobile learning with cellular phone: we do not intend to offer an exhaustive review of the area, but rather to point out various existing research direction. Section 3 presents our system and the overall support architecture, which is integrated with an existing service for asynchronous fruition of (video)lectures. The following section discusses our experience and draws the conclusions.

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1 http://www.symbian.com/

2 http://java.sun.com/javame/index.jsp

3 http://www.apple.com/iphone/

4 http://www.apple.com/itunes

2. A synthetic view of the existing research

The literature on cell phone supported learning has examined various complementary aspects. Some people focused on the messaging capability: in the book (Attewell 2004) , 17 papers were at least partly concerned with SMS as a mobile learning component. Some people (like e.g. Mitchell et al. 2006) studied how SMS can be used to deliver mobile learning services and administrative information on a personalized basis. Others focused on more learning-related activities, like testing (Tretiakov 2005) or as a using push technology in learning foreign languages (see e.g. Thornton 2001). Yet another point of view is to consider SMS as a mean for students to interact with teachers and with their peers.

A different cellular phones use is based on the possibility of using them as devices capable to deliver content. In this case the nature of such devices, with their small screens and poor input capabilities, puts some limitations on what can be done, and limits some of the functionalities that are available on standard desktop computers or laptops. For instance, (Maniar et al. 2007) found that on a device with a small screen (42mm diagonal) the effectiveness of an m-learning environment that relies heavily on video-based material the learning experience may be inhibited, while a slightly larger screen (58 mm diagonal) makes the experience acceptable.

On the other hand, it is probably true that not all e-learning functionalities can be implemented (at least in a user friendly way) on such devices: not only because of the kind of interface (no real keyboard, small screen etc.) but also because of the probable kind of use. Such devices will be used mostly on the move, and typically for a rather short time spans. In literature are available some guidelines on how to effectively use them (see e.g. Steinberger 2002, Figg 2002). As (Trifonova et al., 2003) summarize them:

- "Modules should be short, and last no more that 5-10 minutes. Users should be able to use their small fragments of waiting or idle time for learning, by reading small pieces of data, doing quizzes or using forums or chat.
- Simple, funny and added value functionality. It should be possible to use an m-learning system without reading a user manual, and the experience of studying with the help of such devices should be interesting and engaging.
- Area/Domain specific content, delivered just in time/place. The mobility should bring the ability to guideline and support students and teachers in new learning situations when and where it is necessary. The dependency of the content can be relative to location context (i.e. the system knows the location where the learner resides and adjusts to it), temporal context (i.e. the system is aware of time dependent data), behavioral context (i.e. the system monitors the activities performed by the learner and responds to them adjusting its behavior) and interest specific context (i.e. the system modifies its behavior according to the user's preferences)."

Although these suggestions seem quite reasonable, a very popular research direction is based on the Apple ipod, and seems to violate these indications. The first paper about using ipods in education we are aware of (Crawford 2003) appeared in 2003. Since then there has been an exponential growth of papers on this issue: by searching ipod and podcasting in the AACE Education and Information Technology Library[5] which covers some of the major conferences in e-learning, one finds 2 papers in 2005, 11 in 2006 and 35 in 2007! 4 more papers can be found by searching for MP3. The reasons why these papers do not comply with the above reported suggestions are that there is *no location awareness* and often they *do not foresee short activities*. The usage is certainly simple – whether it's also entertaining probably depends on the way the content is presented. However the large number of reports on using such technology indicates that probably there exists a useful niche for audio devices as mobile learning tools.

A stream of work related to podcasting, albeit different, concerns the diffusion of videolectures over the Internet (see e.g. Ronchetti 2008). Once more, this simple idea was pioneered ten years ago (Heyes 1998) and it is nowadays becoming very popular, with many videolectures being made available as youtube videos. In both the podcasting and the videostreaming approaches, the idea is to reuse existing events (e.g. traditional lectures) by recording and diffusing them in digital form. Over the years various flavors of this idea have been put into practice. Pure podcasting uses only the audio track, pure video uses both audio and video, and more sophisticated forms such as the LODE

[5] http://www.edtlib.org

system (e.g. Ronchetti 2003) include synchronized PowerPoint slides, the possibility to include additional material, high resolution pictures of the blackboard and podium (Canessa 2007), semantic markup, possibility to search into transcripts of the audio track (Fogarolli 2007) etc. The important point is however to focus on the right cognitive channel, and therefore in some cases the video track is ignored in favor of images (e.g. of the slides), like in the case of the so called “Webinars” (a portmanteau of “Web” and “Seminar”).

3. Some preliminary considerations

When bringing traditional lectures on a cellular phone one should decide what is the best way to achieve the desired result. It would be possible (and actually very easy!) to port a video of the lecture on a cellular phone. Many of these devices can in fact play some standard video stream format (e.g. AVI), and tool for transforming high resolution AVI into highly optimized streams adapted to the size of the phone’s display are available. Such videos can typically be browsed by moving back and forth with a cursor representing the time bar.

The drawback of such solution is that there are no semantic clues, and it is very difficult to find a particular place in a lecture: more or less like it happens with a VCR – and we know that videolectures on VCR, albeit used in several projects since the 80’s never became a real breakthrough. In our view, this is due in part to the cumbersomeness of obtaining the physical medium, and in part to the difficulty of easily and quickly finding the right material when it as needed.

An even more important drawback is relative to the importance of the cognitive channel. Can a traditional lecture be followed and understood only by listening to the voice of the teacher? It obviously depends on the discipline and on the teaching style. In some cases a blackboard is an important support – in such cases the visual channel becomes very important – but it is also very important to have a high resolution. In other cases the cognitive focus is on the projected slides – even though not all the lectures that use PowerPoint-like slides actually need them – in fact in many cases the slides are a mere support for the teacher!

So obviously the cognitive channels that are being used dictate the right media that should support the lecture, and the feasibility of using a certain class of devices. The (obvious) conclusion we draw from these consideration is therefore that the approach that is so fashionable today – audio podcasting – is only good for the subset of lectures that do not need visual clues. The full video channel is important in many other cases – but the available resolution on a cellular phone screen compromises those videos in which small details can be important – like in the case of handwriting on a blackboard. A webinar-like approach (i.e. audio plus images of the slides) is certainly successful in many cases – provided that the slide content be clearly legible.

We decided to follow this approach and to try to solve the resolution-related problems in a user-friendly way on cellular phones. Besides being useful, such approach is also effective since it uses far less storage than a full video, and also has the advantage of presenting a natural semantic markup of the content given by the slide titles.

4. Description of the system

Our system makes the recording of lectures available on a cellular phone. We start from the lectures recorded with the LODE system and produce a package that can be uploaded on the phone and played asynchronously. LODE produces a video of the lecture coded both as MP4 (readable e.g. from QuickTime) and as FVM (Flash Video Movie) for web consumption. Moreover, it creates a series of JPEG files representing the images that were used during the lecture (such images are converted from the original PPT, HTML or PDF file) and an XML file containing the titles of the slides and the transition times. From a conceptual point of view, the video can be considered as the sequential composition of logical sections, each of which corresponds to a slide.

The conversion process is fully automatic. We use IrfanView to transform the images from the full format to the right resolution(s) for the cell phone screen. Ffmpeg is used to extract the mp3 audio track from the video, and to re-encode it into an amr file with parameters suited to the phone. Mp3split takes the audio stream and chunks it into segments. Loading a full lecture into the phone’s active memory is in fact impossible, and it is necessary to split it into portions. The chopping is done in a flexible way, so as to making one or more logical sections

An ad-hoc program creates an archive containing images at various resolutions, headers of the logical sections (taken from the XML file produced by LODE) and the audio.

The archive can be downloaded on the cell phone, together with the controlling software that we developed. The cell phone must be a model operated by Symbian. Symbian (owned by Nokia, Sony-Ericsson, Panasonic, Siemens and Samsung) is a multithreaded, pre-emptive multitasking operating system with memory protection. Besides the owners of the system, also other producer of cellular phones (like e.g. Motorola) base at least some of their products on Symbian. Such choice of the platform is therefore not a strong restriction to portability of our software. Our system was developed and tested on a Nokia N70 – tests on other phones are presently being carried on. In general is has been designed to be usable on devices with a standard screen size of 58 mm. A larger screen does not harm but is not requested.

Our controlling software was developed using Java Micro Edition. In such environment, the CLDC (Connected Device Limited Configuration) provides the API for programming devices of the class of cellular phones, and in particular includes MIDP 2.0 (Mobile Information Device Profile) which provides API for the graphic user interface that are powerful enough to implement basic 2D games.

During development we encountered difficulties due to several factors. We could not assume to have a large RAM: in some cases it might be limited to 64 Mb (for models presently sold, but even less for older modes). This was the main reason to decide to chop lectures into pieces. The available memory for storage is also limited: the solution was to extended it by using inexpensive memory cards. JavaME does not have libraries for performing direct access to files: therefore every access to file is either relative to the present position, or one has to restart from the beginning of the file. We needed to overcome such shortcoming by packing data in our own memory structures that we could scan in memory. Moreover, for security reasons every access to a new file needs to be explicitly authorized by the user through a pop up box. To avoid doing so one would need to use certificates that, once accepted by the user, bypass the need of an explicit authorization. Unlike the case of PCs, certificates can only be issued by the owner of the operating system and they are rather expensive, so that we could not follow this path – at least not for our prototypical development. Some known bugs (officially recognized by the Sun corporation) affected the time setting of the audio player on phones based on older versions of the firmware. Also a garbage-collection-related bug produced some minor problem in the deployment, but overall the system is running well and in a stable way.

When the user starts using our software, the first choice is which lecture to load. Choices are presented in the form of a menu, as shown in figure 1.

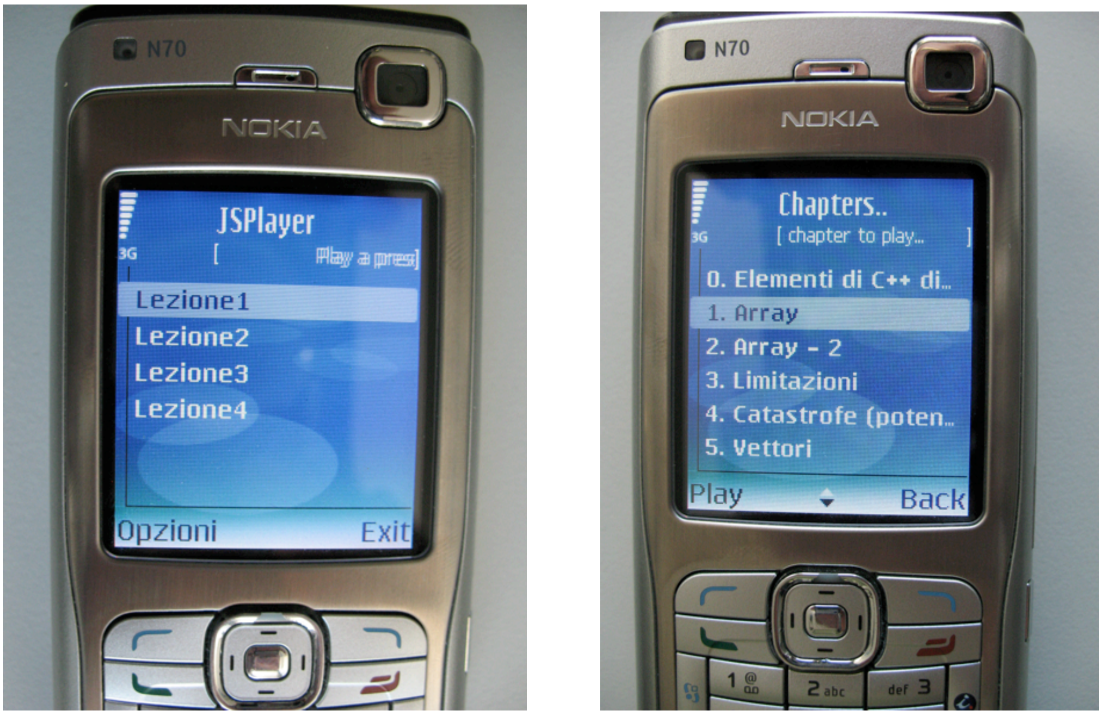

Figure 1: On the left the choice of the lecture, on the right the choice of the chapter within the lecture.

During a lecture, the user can recall a menu that allows to choose a logical section (called a "Chapter" in the interface), that corresponds to a slide. When a section is chosen, the phone starts playing the audio for that section, and presents the corresponding slide in full size, as shown in Fig. 2a.

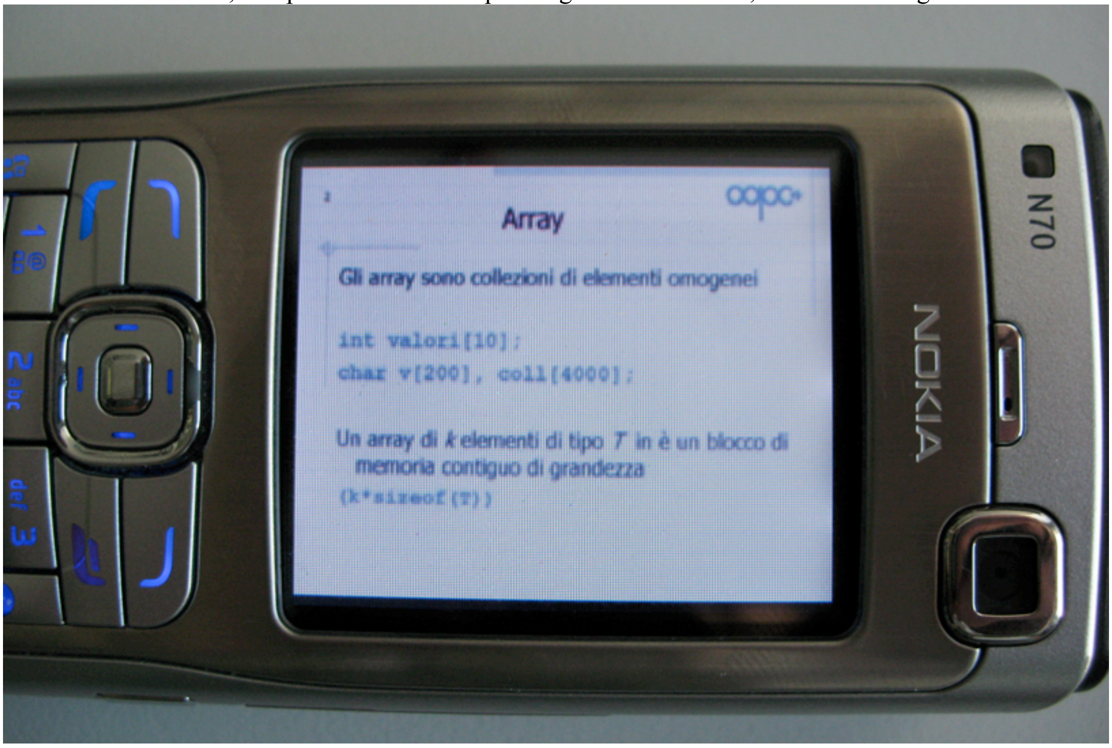

Figure 2a – The view of a slide in full size

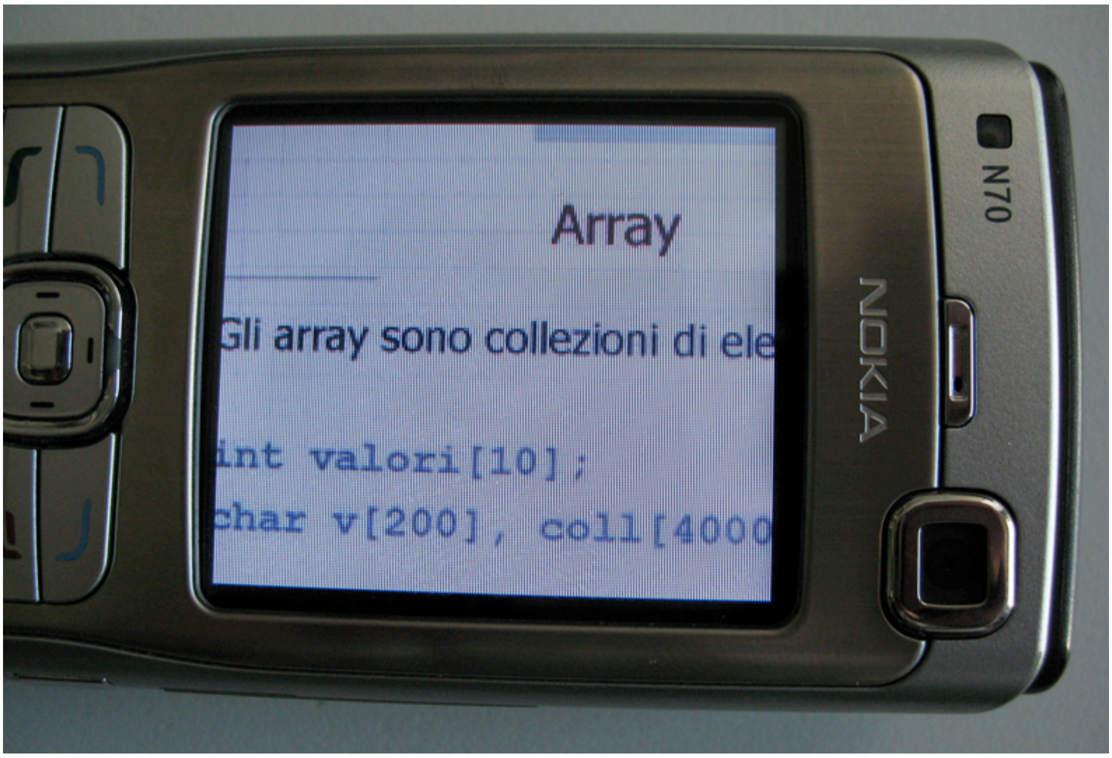

Figure 2b – The view of a zoomed portion of a slide.

An average slide is readable at this definition – but of course there might be slides using smaller fonts or showing tiny details. In such cases the user can zoom in by a factor two by pushing one of the

phone's keys. Since the full slide does not fit any more into the screen, the user can move it in N-E-S-W directions by pushing buttons that reflect that spatial arrangement. Figure 2b shows the zoomed-in slide. The user can also move away from he current slide (to check the content of one of the previous, or to preview one of the following slides. In most cases s/he will be mostly listening, paying attention to the slides' content when needed.
Besides navigating by chapter, it is also possible to move fast forward/backward. This is useful for performing a local search or for skipping a short section, but it is most useful for recovering lapses.
We must remember n fact that such system will be mostly used on the move, in an environment where other facts or events might temporarily capture our attention (like checking out of a train's window the present position) therefore disturbing the concentration. Hence the need to be able to reposition the stream to a nearby position.

5. Discussion and conclusions

We developed a system to port traditional lectures on a cellular phone. The system we developed is functional and usable. It is suited to a class of lectures for which the visual cognitive channel can be limited to the content of PowerPoint-like slides, and can of course be used also for those in which only the auditive channel is needed. The case of a more intensive use of the visual channel would be simple to implement but the resolution of the device prohibits using it. We tackled with usability issues, offering an effective solution to the problems related to the screen size for the static images that accompany the sound. A certain level of semantic marking of the lectures makes it easy to stop a lectures and resume it at a later time, and also to search for a particular content.

Validation of the system has been limited to informal tests, which suggest that the system is in fact usable and useful. Usage include recovering lost lectures or portions of them, reviewing learning material (or portions thereof). The system can be used while commuting, or when not too small time fragments are available. We plan to perform a more systematic and complete evaluation as soon as possible.

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