Ubiquitous Computing and Streaming Technologies for Synchronous m-Learning - A Mobile Environment for Remote Laboratories

Andreas Bischoff, http://prt.fernuni-hagen.de/~ bischoff/

Providing students with html, pdf or WAP static text based learning material for m-learning is state of the art. Solutions like PDF viewers and browsers like PocketIE, Opera, Netfront and Minimo are able to render text in a useful way on the limited screen sizes of todays PDA and smartphones. To support active, non static, multimedia, Virtual Reality or streaming content we have adapted our web based remote laboratory environments to mobile devices like PDAs and smartphones. Today's PDAs have displays up to 640x480 pixels resolution, which is enough to control our experiments. The modified client Java applets are running on a 'Personal-java' virtual machine. 'Personaljava' is a Java run-time environment for mobile devices with limited resources.

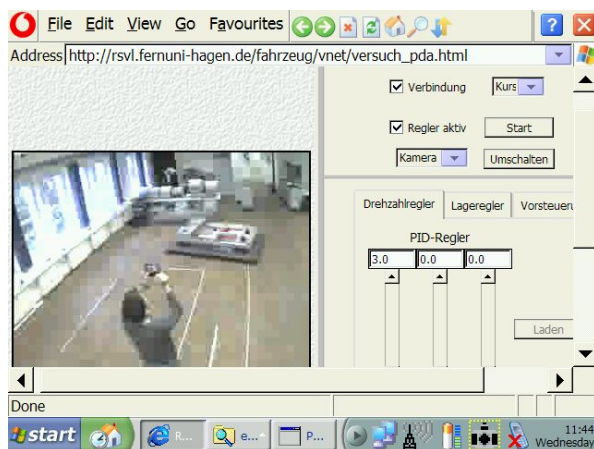Figure 1: Pioneer AT-3 mobile robot remotely controlled by a Windows CE NET smartphone (bSquare Maui)

Figure 2: Screenshot of a remote experiment rendered by PocketIE on a bSquare Smart-phone, 640x480 pixels (Control of a mobile robot platform)

Different to J2ME, the 'Personaljava' implementation provides the full AWT (Abstract Window Toolkit) API. Implementations of Personaljava are available for Windows CE, Linux, Palm and Symbian OS based PDA and mobile phone platforms. Our favorite streaming solution (SUNs Java Media Framework JMF) is not available on mobile platforms. As an alternative for mobile users we provide a MPEG4 based video stream, generated by the Linux based ffmpeg/ffserver [1] solution. As container we are using the Microsoft ASF streaming format. ASF was natively supported by PocketPC variants (PocketPC 2002, Windows Mobile 2003, Windows CE NET). For Linux based PDAs the VideoLan player is an alternative. On Windows CE based PDAs and smartphones the ASF/MPEG4 stream is embedded to a webpage with an ActiveX control.

[1] http://ffmpeg.sourceforge.net/

[2] Andreas Bischoff, Virtual Reality und Streaming-Technologien in der Web-basierten multimedialen Lehre und für Ubiquitous Computing, Dissertation, University of Hagen, Department of Electrical Engineering and Information Technology, 2005 (in print).

[3] Andreas Bischoff. Kollaborative virtuelle Umgebung für Online-Praktika und Seminare. In 39. Regelungstechnisches Kolloquium in Boppard, February 2005.