The Western

also wanted a base system with a rich feature set to support user interface and applications research, as well as the flexibility to easily add new capabilities. Criteria such as cost or suitability for volume manufacturing, which are of utmost importance for commercial products, played no significant role.

We chose a StrongARM processor for Itsy because it met our performance requirements with a superior MIPS per Watt ratio, and offered power-saving features such as *sleep* and *idle* modes (see Section 3.5). From among the StrongARM family, the SA-1100 [1] was chosen for its on-chip controllers that made it easy to build a complete system with few additional components.

The minimum size and weight of a small system is generally bounded by its battery and display. This trend is certainly true for Itsy, which is just 70% larger than these two components alone. Our Li-ion cell is just large enough to plausibly allow a full day of intermittent use, and the display was chosen mainly for its small size. The motherboard and an auxiliary board fill the remaining space. The amount of flash memory and DRAM was determined by the maximum number of parts that would fit without making the system still bigger.

A key attribute of our design is a flexible daughtercard interface. Unlike common extension standards (such as PCMCIA and CompactFlash), all the available functionality that could be used by a daughtercard is accessible, incluhncceactFlash), (cluhiat)dm,uperi34 ea49(csible3)-2ataeeri34 ieercardby

Figure 2: Itsy v2 architecture.

DRAM banks:

Peripheral	

The first application environment available on Itsy was Squeak [7], a portable Smalltalk-80 system. Squeak applications have been developed on both Windows and Macintosh systems for Itsy. Existing applications such as a multi-voice music synthesizer run with no changes. A heap image can be saved on either of these systems and run on Itsy merely by changing the display depth and clearing a flag in the SoundPlayer.

The Itsy also supports the *Kaffe* Java system from Transvirtual Technologies. Kaffe includes a

System	OS	CPU	CPU (MHz)	V2.1 MIPS
SGI Indigo2	IRIX 6.2	MIPS R10000	195os re8T 70.93 -4.06	SGI O2 R10000/E5 63.81 -4.06

Application	Static size (MB)	Dynamic size (MB)
X libraries	1.9	–
X client binaries	1.8	–
X server	0.7	2.2
DECtalk	1.0	1.5
TalkSoft	0.4	1.5
Doom binary	0.5	3.0
Doom data file (wad)	4.1	–
Dragon dictation	16.7	25.0

Table 5: Application memory requirements.

Dragon NaturallySpeaking continuous-speech dictation engine runs about 2.4 times slower than real time.

5.2 Memory usage

As mentioned in Section 3, Itsy has 32 MB of DRAM and 32 MB of flash on the motherboard. For historical reasons, the flash is partitioned into two sections. The first partition is 4 MB and contains the boot monitor (400 KB), the compressed kernel (370 KB) and about 3 MB for the compressed root filesystem. The second partition is 28 MB and is used for the flash-based filesystem described in 194 0 -13.55 Td5(The)1302(DRAM)-312(is)1301(used)1372(for)1371(k)10(ernel)1372(and)137programAMFa

Dragon NaturallySpeaking (experiment 15), a continuous speech recognizer, really stretches the

based, allowing alternate operating systems to be installed. An Open Handhelds website [16] was recently announced to encourage and facilitate the creation of open source software for use on handheld and wearable computers. While initially sponsored and hosted by Compaq, outside participation has grown and additional sponsors are expected. A Linux 2.4 port and other utilities for the iPAQ are available now at this site.