Portable Amiga-based Handheld Workstation

Confidential

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Chapter 1
Introduction

1.1 New World Technology...

Since there hasn't been any development on so-called "classic" Amiga systems since the early 90s, several companies have lost their hope already and decided to continue their activities on the PC and Mac market. However, the Amiga is one of the very few desktop computer-systems that have not fallen into the hands of Microsoft and is still being worked on today. Many other companies such as Apple, Acorn, Atari, Sega etc. went bankrupt or sold theirselves to Microsoft to continue their "existence". The instability and inefficiency of current mainstream systems asks for a change.

Nearly 10 years after Commodores last major change in the Amiga architecture, there has been so many third-party upgrades over the years that the machine is still up-to-date. The Amiga is the only computer with a userbase, softwarebase and hardwarebase so huge and powerful that it could actually survive more than 6 years after its mother-company went into bankruptcy. Being the only machine supplying true multitasking, memory-efficiency and CPU-efficiency simultaneously it isn't surprising that its capabilities are still very impressive today. The design of this machine and its superior operating system (OS) would be perfectly suitable for use in handheld devices.

Even though the world of handheld machines is growing faster and faster every day, it seems that there is still no machine good enough to supply workstation-performance while offering multi-system compatibility and good entertainment-software as well. This is where the Amiga comes in: This new handheld will be the first multi-purpose mini-computer offering superior performance only seen before on high-end desktop systems. Actually, with the efficiency of the AmigaOS, it should be able to outperform any affordable system available today.

The handheld itself will be running on AmigaOS PPC and supports several other parallel running (slave-)systems as well. The most important supported system besides the Amiga is definitely the PowerMac, since this computer is still used worldwide and has a very large and professional software-base as well. **Some** of the other systems supported are: Sega Megadrive, Super Famicon/Nintendo, Gameboy, Gameboy Color, Nintendo Entertainment System (NES), Sega Master System, Sega Gamegear, Commodore C64, Commodore Plus4, Arcade machines, Atari Lynx (limited support), PC Engine (limited support) and, if current development will proceed, Sony Playstation and Nintendo N64 as well.

The aim of this handheld is to make an almost futuristic machine with features never seen before on any computer, while keeping the price as affordable as possible.

Chapter 2
Overview

2.1 Hardware

- Motorola/IBM MPC755 (G3) or MPC7455 (G4)main CPU clocked at a minimum of 400MHz
- Motorola DSP56002 or DSP56301 side-DSP for parallel processing
- Minimum of 256 kb Level 2 Cache, supports up to 2 MB
- Hardware rasters and VBlank Interrupt for screen/video-synchronization
- Handheld-part expandable with mobile 3D-hardware
- 320x240 color LCD-screen with scrolling features on the handheld (hardware supports bigger LCD-screens: a higher resolution screen may well be used instead if the price becomes more affordable at that time)
- Dataplay next-generation disk drive (more than 500MB on a small floppydisk)
- 16MB memory expandable to 64MB on the handheld and 1024MB on the docking station, shareable as chip- or fast-memory
- 16MB Flash-memory (expandable) for system-resources
- DSP and MMU-table-based emulation of the Amigas most important customchip-features
- 16-bits stereo sound-codec
- PCMCIA ports
- SVGA and SCART RGB output, RF-output as an affordable option
- All-in-one smartcard solution
- 56k internal GSM modem
- Powerful slot to connect with the Docking Station
- The Docking Station contains USB, PCI and AGP slots, 3D hardware, parallel/serial interfaces, IDE/SCSI and several other features to expand the handheld to a fully expandable desktop-machine.

2.2 Software

The system runs a modified version of AmigaOS, running natively on the PowerPC chip. The internal interface of the system is self-rerouting, which means that the Operating System decides if a program or system-resource will be executed on the PowerPC or under emulation of the previoulsy used 680x0 chip. Besides, several new features have been added to the OS to make it run 100% stable on the handheld with full benefit of the available hardware.
PowerPC software uses Haage&Partners WarpOS to run: This is no longer a subsystem (as it is with current Amigas) but a fully implemented part of the main-system. 680x0 Software will run faster than any Amiga-system available today, since the 400MHz G3 can easily manage this. For more information on the AmigaOS, please refer to **Chapter 2.3 AmigaOS.**

Supplied with this system is a lot of freeware pre-installed software: Emulators (PowerMac emulation is an option since it requires the $200 iFusion to run), Amster (high-end Napster client), (STR)ICQ, AmiTradeCenter (Super FTP client), AMIRC, AmigaAMP (MPEG audio player), MCP, Toolsdaemon, MagicMenu, Birdie, Powersnap, Directoryopus 4 (next-generation file-management utility), Lame (mp3 encoder) and several other programs.

There are also commercial packages bundled with the handheld: AMP (MPEG Video decoder), MooVid Pro (fast AVI/MOV player), Magic User Interface (MUI) and Shogo, Heretic II, WipeOut 2097 or Payback.

The entire software-environment can be tested and developed on the currently available Amiga A1200/A4000 systems with PowerPC accelerator card installed. This means that both the software and hardware side of the handheld can be developed in parallel.

2.3 AmigaOS

AmigaOS is known as one of the most powerful operating systems ever and this is primarily caused by the efficiency of memory and CPU usage together with its unique multitasking capabilities. The Amiga is one of the very few systems working with multiple screens, which means that a program can open on the Workbench (the desktop) screen itself or its own virtual screen hiding behind the Workbench and popped up to front by using an on-screen system gadget. All these features and several more make the AmigaOS a perfectly suitable system for handheld usage: On any other system, all programs open on the same screen, which is not really useful in the <640x480 resolution used for the most affordable and common handhelds today.

Several parts of the AmigaOS have to be altered for use with this handheld. First of all, the bootup code of the handheld should be calling AmigaOS after showing its bootpicture and the Early Startup Menu (See **Chapter 2.3.1).** AmigaOS must be prepared for this, since normally it is booted using the 68K processor. The handheld has a little ROM to boot up, calling the AmigaOS only when requested.

The handheld is supplied with WarpOS as well, featuring 68K emulation to support backwards-compatibility with the huge base of 68K programs. The G3/G4 CPU is able to reach faster-than-68060 speed without the side-effects of context-switches involved in current Amiga-systems.

There is a very huge software-available for the AmigaOS, containing many professional titles. Besides, the PD/Shareware-base is very large with high-quality titles as well and most of them are easily downloadable from the Aminet Online-archive and its worldwide mirrors. Many of these programs are much better, faster and more stable than similar (even commercial) programs hosted on other platforms.

2.3.1 Early Startup Menu

The Early Startup Menu is a unique feature added to the modified version of the AmigaOS. This menu is always showed on startup and is actually a layer of the system to easily select what you would like to do with the machine.

What you can actually see is a decent interface with some symbols on screen. You can scroll through these symbols and click on them as well. These symbols represent the many systems that can be emulated, the AmigaOS, the internet-environment and e-purse based transactions. The advantage of this menu is that the operating system does not have to boot before you can actually do something with the handheld, offering maximum flexibility.

While this menu is on screen, the machine takes its time to boot the AmigaOS as a background process. By the time you push the symbol representing AmigaOS, the system is already booting/booted. Keep in mind that system booting is very fast on the AmigaOS, making resetting a less frustrating event as well as making life easier when a crash occurs: AmigaOS does not require a shutdown.

2.3.2 Online-help

Since this machine must be controllable by anyone (also people who have almost no computer-experience), nearly every single OS-based operation should have its own online-help “balloon”. German, French, English and Spanish languages should at least be available.

2.3.3 OS Layers

The entire OS model of the handheld can be split up in the following layers:

MAIN SYSTEM - HANDHELD ROM
- **Early Startup Menu**
- **AmigaOS**
  - **Workstation Environment**
  - **Sub-system Environment**

This actually means that the HANDHELD ROM calls the Early Startup Menu or the AmigaOS, depending on the configuration of the unit. The Early Startup Menu and AmigaOS both belong to the same layer, since they have to work together: The Early Startup Menu uses AmigaOS for both its interface and the programs selectable from the menu.

Both the Early Startup Menu and the AmigaOS must be active in order to gain access to the Workstation Environment (internet-access, audiovisual editing, mp3 playing, video playing, Amiga games etc.) and the Sub-system Environment (All the emulators). The Early Startup Menu can still be accessed when AmigaOS is running.

The Workstation and Sub-system Environments work fully independent, being seperate tasks.

2.4 Purpose

Unlike all other handheld devices out there, this one has no limitations in flexibility: Nearly any kind of application is available on this platform. Examples are 3D-rendering, high-end (online and offline) 2D and 3D games, MPEG/OpenDivx/AVI/MOV audio/video playing, internet access, electronic banking and payments, wordprocessing, audio/video editing, sequencing etc.

The idea behind this machine is that it allows the user to do everything that was previously only possible using desktop machines and more. This means that it could actually be able to eventually replace the desktop machine: This handheld uses a system that runs nearly transparent to the user while having full control over the system if required. All the problems and instability-issues of the PC market belong to the past, since Amiga-software is very memory and CPU efficient. Besides, several (emulated) sub-systems are included in the AmigaOS to gain access to a

gigantic amount of software. But it is not just a mini-workstation: It is a full smartcard solution as well allowing electronic payments, cardloading and other smartcard related features normally only accessible using more smartcard-specific hardware.

But there is even more: Since the measurements of the handheld device are too small to provide workstation-like expandibility, a Docking Slot has been added to the system. This slot is used together with the optional Dockin Station, a device to click your handheld on for maximum flexibility. When the handheld is plugged into the Docking Station, the LCD display will automatically change into a status-display and the screen-information is re-routed to the SVGA/RF/Video/RGB output(s). Since the Docking Station uses a Power Supply Unit, the handheld is no longer depending on its battery, allowing it to run at maximum performance. The Docking Station provides PCI, AGP, USB, parallel, serial, IDE and SCSI ports, as well as several other connectors and 3D hardware.

2.5 Simple Customchip Emulation Details

2.5.1 Overview

The emulation of the Amiga's customchips makes use of the following hardware:

- 2-channel (Stereo) 16-bits standard audio codec
- Replacement timers connected to the PPC/DSP Interrupt lines
- Hardware VBI (Vertical Blank Interrupt) and rasters
- DSP56002 or DSP56301 Digital Signal Processor

2.5.2 Description

The customchips are emulated using MMU-tables and the on-board DSP. This means that when access to a customchip-location is detected, the PowerPC chip or interrupt-line automatically tells the DSP to do a certain operation. Not all the customchip-features are emulated, but only the most important parts.

The sound-part of the hardware should be Paula-compatible in a way that it has been made register-compatible with the audio-registers of the Paula-chip. This is handled completely by the DSP to prevent the PPC from being slow-downed. Since the hardware supports 16-bits stereo sound it is capable of playing Paula 14-bits sound using trickery.

The DMA register is a dummy register to enable/disable the sound. This is only required for compatibility with the older Amiga-line: It has nothing to do with the DMA registers of the OCS/ECS/AGA chipsets.

The interrupt-registers are used to allow the hardware to provide an interrupt signal to the G3/G4. Audio and timers can now interrupt the processor when enabled in register INTENA. Software maps the interrupt-signals to the correct locations in memory.

A standard timer-chip is used for 6526/8520 CIA timer-compatibility. Again, software allows this chip to be used as a standard CIA.

2.5.3 Register Configuration

The following locations should be accessible using the CPU/DSP and are therefore emulated in software:

1. CUSTOMCHIP BASED

Readable

$dff002 - DMACONR - Read-access to DMACON ($dff096)
$dff01c - INTENAR - Read-access to INTENA ($dff09a)
$dff01e - INTREQR - Read-access to INTREQ ($dff09c)

Writable

$dff096 - DMACON - DMA control register

Bit 15 - Set/Clr Bit
Bit14-10 - Dummy Bits (0)
Bit 9 - Enable Audio DMA
Bit 8-4 - Dummy Bits (0)
Bit 3-0 - Audio DMA channel 0-3

$dff09a - INTENA - Interrupt Enable register
$dff09c - INTREQ - Interrupt Request register

(For both INTENA and INTREQ:)

Bit 15 - Set/Clr Bit
Bit 14 - Interrupts enabled
Bit 13 - Interrupts from Timer-B
Bit 12/11 - Dummy Bits (0)
Bit 10-7 - Audio interrupt channel 0-3
Bit 6 - Dummy Bit (0)
Bit 5 - Vertical Blank IRQ
Bit 4 - Dummy Bit (0)
Bit 3 - Interrupt from Timer-A
Bit 2 - Reserved for software IRQ
Bit 1-0 - Dummy Bits (0)

$dff0a0 - AUD0LCH - audio-data address high 16-bits (channel 0)
$dff0a2 - AUD0LCL - audio-data address low 16-bits
$dff0a4 - AUD0LEN - audio-data length
$dff0a6 - AUD0PER - audio-data period
$dff0a8 - AUD0VOL - audio channel 0 volume
$dff0aa - AUD0DAT - (dummy register)
$dff0ac - AUD0LSB - audio channel 0 volume (2 lsb’s)

$dff0b0 - AUD1LCH - audio-data address high 16-bits (channel 1)
$dff0b2 - AUD1LCL - audio-data address low 16-bits
$dff0b4 - AUD1LEN - audio-data length
$dff0b6 - AUD1PER - audio-data period
$dff0b8 - AUD1VOL - audio channel 1 volume
$dff0ba - AUD1DAT - (dummy register)
$dff0bc - AUD1LSB - audio channel 1 volume (2 lsb's)
$dff0c0 - AUD2LCH - audio-data address high 16-bits (channel 2)
$dff0c2 - AUD2LCL - audio-data address low 16-bits
$dff0c4 - AUD2LEN - audio-data length
$dff0c6 - AUD2PER - audio-data period
$dff0c8 - AUD2VOL - audio channel 2 volume
$dff0ca - AUD2DAT - (dummy register)
$dff0cc - AUD2LSB - audio channel 2 volume (2 lsb's)
$dff0d0 - AUD3LCH - audio-data address high 16-bits (channel 3)
$dff0d2 - AUD3LCL - audio-data address low 16-bits
$dff0d4 - AUD3LEN - audio-data length
$dff0d6 - AUD3PER - audio-data period
$dff0d8 - AUD3VOL - audio channel 3 volume
$dff0da - AUD3DAT - (dummy register)
$dff0dc - AUD3LSB - audio channel 3 volume (2 lsb's)

2. CIA-BASED

CIA-A

$bfe001 - PRA - Mouse-button reading
$bfe401 - TALO - See "TAHI"
$bfe501 - TAHI - Keyboard communication timer 1A
$bfe601 - TBLO - See "TBHI"
$bfe701 - TBHI - Timer 1B
$bfe801 - E. LSB - See "E. MSB"
$bfe901 - E. 8-15 - See "E. MSB"
$bfea01 - E. MSB - Event counter, counts powerfrequency ticks
$bfeb01 - SP - Keyboard code input
$bfec01 - ICR - Interrupt control register
$bfee01 - CRA - Control Register A

CIA-B

$bfd400 - TALO - See "TAHI"
$bfd500 - TAHI - timer A (user-based)
$bfd600 - TBLO - See "TBHI"
$bfd700 - TBHI - timer B (user-based)
$bfd800 - E. LSB - See "E. MSB"
$bfd900 - E. 8-15 - See "E. MSB"
$bfda00 - E. MSB - Event counter, counts horizontal synchronization ticks

$bfdc00 - ICR - Interrupt control register
$bfde00 - CRA - Control register A
$bfdf00 - CRB - Control register B

Chapter 3
Development Plan

A very important issue is that the system of this machine should already be perfect as it sells. The entire system must be rocksteady and look at its best. Therefore, a lot of hard- and software-development will be involved in this project succeeded by a lot of testing. Pre-testing and development of the custom OS features will be done on Amiga A1200/A4000 systems equipped with a phase5/DCE PowerUp board and Blizzard/CyberVisionPPC (Permedia 2-based) graphics accelerator card, which means that the software-side of the machine does not require any prototype handheld to be produced before the biggest parts of testing/developing can be finalized. However, the selected A1200/A4000 systems should be as close to the handheld-configuration as possible to give an idea of the speed, stability and efficiency.

3.1 Development stages

The first steps to be taken are the software-design, hardware-design and casing. Especially the casing is very important since the machine should have a stylish and modern case, which is a time-consuming job.

While the designer(s) are working on the looks of the machine, development on the prototype model should be nearly finished. This means that the case-designer(s) has/have the ability to know more about the measurements of the device, which is an important issue: At this point, the casing can be constructed since the shape and design of the casing depends on the board-measurements.

Another time-consuming job is the customchip emulation. This will take several weeks and requires a lot of testing. Therefore a team of betatesters should be working on finding bugs while the emulation is being developed. This will speed up the process drastically.

The board will most likely be designed by Martin Schuler. Since compatibility with phase5's PowerUp boards is important, co-operation with Thomas Dellert (DCE) is required to achieve this.

When all this is finished, the entire system-harddisk of the development A1200/A4000 is copied to the harddisk of the prototype model. This is where the software development/hardware debugging stage proceeds for specific use with the handheld.

3.2 Time-schedule and pricing

Two very important issues are the amount of time involved in this project and the price of the device when it is available in the shops.

Aim is to keep the price below $600 for the standard system. This price can only be maintained if the machine can be finished in a relatively low amount of time. It should not take more than 2-3

months to have the prototype board finished. Most of the time will be used for designing the customchip, software and handheld-case.

After this prototype model is finished, the software should be adapted to the handheld before entering the production stage of the machine.

Chapter 4
The Future

Future-proof?

One of the most important issues in building a computer these days is the future-proofness of the device. For example, on the PC market you need to upgrade every one or two years in order to keep up with the new soft- and hardware. Many people can’t affor this and decide to stick with their “older” machine.

The Amiga handheld is built in a modular way, which means it is upgradable in an easy way. However, the G3/G4 CPU is fast enough to be going on for at least another few years. The Docking Station allows the machine to keep up with desktop machines, so connecting the it to a SVGA monitor would supply the performance of a real workstation.

Besides, an Amiga running a G3/G4 CPU is way faster than a Macintosh or PC with a similar CPU on-board (ie an Intel CPU with the same theoretical performance level) thanks to its unique OS design. This means that it is even possible to outperform the speed of modern G3/G4-based Macs when using the Amiga-side of the handheld system.

Thou shalt not bring into the world knowledge and devices that will harm mankind.

- Herbert A. Simon