
by Mark Jansen

Small and lightweight, Atari's new ST Book notebook computer is loaded with sophisticated features and optimized for portable productivity. In this exclusive interview, Explorer's Mark Jansen talks with Tracy Hall, Senior Design Engineer at Atari, who was responsible for developing the core technology on which the Book, and Atari's next-generation pen-based system, the STylus, are built.

Writing the ST BOOK

Atari Explorer: ST Book is built around a small, low-power ST-compatible computer. How did that project begin?

Tracy Hall: It began when I was brought in as a consumer product developer. I was to help Atari find another approach into the United States. That's what ST Book and STylus will allow us to do — make more inroads into U.S. markets.

I flailed around, and eventually proposed a device that would let you hand-write into your machine. Originally, it was just a handwriting input method, a pen control method, not an ST per se. The idea was to build something inexpensive to allow you to do hand control, hand entry of information; you'd use it as a personal controller, organizer kind of thing.

Then, research showed we could use the STe chipset to build a machine with low power consumption. Most of the chips were CMOS; only a couple of things weren't, like the floppy-disk controller. I decided to build this machine from the ST, so it evolved into a larger, more powerful basic machine.

AE: How was that basic machine developed?

TH: We began with a rough design, and crossed out everything that wasn't absolutely necessary. It was like making a statue of an elephant — take a block of cement and chip away everything that doesn't look like an elephant.

The first six months saw no hardware built at all. We defined what we wanted, thought out what we needed, what we could sacrifice, and how we could save power. It was very, very carefully thought out. Over the next few months, we did the final logic design and early prototypes.

I did things to save five milliamps here and three percent there; for example, we used a new RAM-refresh scheme to save power. Only one pair of RAM chips is fully turned on at any one time, whereas the STe turns on all of RAM at once and refreshes it.

We used pseudostatic RAM, because it saved about ten percent over dynamic RAM and used the least power for its density. Given the battery life we wanted, that was significant.

We eliminated video output, since it burned as much power as the rest of



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ONLY FROM THE DESKTOP. BUT ALSO WHILE YOU ARE RUNNING PROGRAMS. FOR EXAMPLE, IF YOU WANT TO CHANGE THE FONT OF A FILE FROM A WORD PROCESSOR, YOU CAN USE THE FILE MENU TO CHANGE FONT FROM THE WORD PROCESSOR. MOST PROGRAMS THAT USE THE MENU BAR YOU CAN ACCESS DESK ACCESSORIES. DESK ACCESSORIES ARE THE FILE MENU BAR INCLUDING THE DESK MENU.

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Digital Clock
05:28:40 PM

the system put together; I doubled the battery life that way. With a Liquid Crystal Display (LCD), all you need is the LCD controller; very few people carry color monitors in their pockets anyway.

We also decided we didn't need a backlight; we use a very high contrast LCD.

AE: Why no backlight?

TH: ST Book will be used in lit conditions. All you need to see the screen is a small gooseneck light, which musicians, for example, have anyway. We're also talking to third-party companies about doing an ST Book light.

The backlight in STacy uses something like five or six Watts of power. ST Book, when running, uses about one and a quarter Watts, total. If we used a STacy backlight, we'd have about a forty-five minute battery life. We felt it wasn't worth it.

AE: What does ST Book weigh?

TH: Two kilos. 4.4 pounds. That's with the forty-megabyte hard drive and a NiCad pack. It's one of the lightest notebooks around; in fact, you can put two ST Books, two AC adapters, two NiCad packs, two alkaline packs, and two power cords in a STacy case, and it still weighs less than a STacy.

AE: STacy and ST Book are both portable STs, but the machines are very different, and have different development lineage. Why?

TH: The philosophies were different between STacy and ST Book, which accounts for the difference in the machines. STacy was an ST put into a portable case. Everything stayed; it's the same circuitry as an ST. When you include all possible features, you end up with a larger machine.

ST Book is a different approach — a lightweight, fully functional, portable machine with a minimum five-hour battery life. Anything that didn't contribute to that was left out.

AE: What were some things done to the core machine to produce ST Book?

TH: We built a new IDE interface for an internal hard drive, and left the floppy drive external, because of the



Tracy Hall, shown here with an early prototype of the ST Book — the so called "Wooden Book."

power used by its controller. In most portable applications, given a choice between a forty megabyte hard drive and bags of floppies, the hard drive is an obvious win.

We also developed the Vector Pad. The idea was to fit a mouse substitute into the machine, so you didn't have something on a cord when there's not a lot of space to run a mouse around. It made a good substitute in a small machine; it's very

small, easy to use, and durable.

AE: The Vector Pad is a small disk you "lean" in the direction you want to move the mouse; the harder you lean, the faster it moves. How does it work?

TH: The Vector Pad is a force-sensing device. There are four sensors: top, bottom, left, and right. When you push in any direction, the force is distributed between the two closest sensors. The balance of that force depends on how close you are to either sensor; in other words, the ratio of the two gives us the angle at which you're pushing. The total amount of force, both sensors added together, tells us how hard you're pushing. We control the mouse direction using the angle information, and the mouse speed using the force information.

The only motion you feel is your finger and the rubber pad underneath it compressing a bit; it takes about five minutes to get used to it. One reason why it takes that time is one Vector Pad and another aren't exactly the same. If you start using somebody else's machine, its Vector Pad may feel different.

AE: To software, it looks just like a mouse?

TH: Exactly. It goes through the new ST Book keyboard controller, and as far as software is concerned, this is a mouse.

AE: Is ST Book completely compatible with the STe?

TH: There are some control bits that were unused in the STe, which we've used to control the new features of ST Book. A couple of programs are sloppy, and alter those bits; for example, one program puts the internal hard drive into Reset Mode. That's a bad behavior and it's because somebody set a bit that they shouldn't have, but because it didn't hurt anything in the past, they didn't

notice.

Cartridges do work, and the expansion port contains all the signals necessary to create a cartridge port. To make a cartridge adapter requires a PC board and two connectors, period. A third party could easily build adapters, or special cartridges.

AE: Is there a BLiTTER chip?

TH: Yes; it uses the combination MCU/GLU/BLiTTER chip from the STe. You can see a difference in graphics performance with the BLiTTER on.

AE: How much memory does ST Book have?

TH: There will be both one megabyte and four megabyte machines available; they are not easily upgradeable. The special power-saving memory refresh uses video access to refresh the RAM. In ST Book, one access to the screen accesses all the chips. That scheme is intimately tied to the size of memory, so you actually have to change control circuitry to change memory size.

AE: What other capabilities does the expansion port have?

TH: It has every signal on the 68000 microprocessor, plus memory control, interrupt control, clocks, all the signals necessary for a cartridge port, and various other useful signals. The specifications have been released to outside developers. It's easy to use, and the expansion port even has the ability to turn the machine on, in case a peripheral needs to do so.

One reason why I put all the 68000 pins out there was so I could hang a logic analyzer onto the system through the expansion port, without opening the case. We've done that extensively, which made it very easy to debug the software.

AE: Are there any new peripherals planned for it?

TH: There is a MIDI expander in design right now. It will provide more MIDI ports, plus SMPTE tracks, to make the ST Book even more useful for musicians.

AE: Other than the expansion connector, what ports does ST Book have?

TH: It has a standard parallel port and standard nine-pin serial port.

The MIDI connectors are smaller than normal, be-



cause of the size of the machine. However, you will be able to buy an adapter so you can use your regular MIDI cables, and a third party will probably come up with MIDI cables that plug right into the ST Book.

The floppy/ACSI port, which I call "Pseudo-ACSI," is another new connector. It contains the same signals as an ST Hard Disk port, with enough signals added to control the external floppy disk controller. We'll probably include a cable that will allow you to connect ST devices like hard disks or laser printers directly.

Next to the keyboard, there's a small ten-pin connector; we could build a numeric keypad that would plug in here. There is even a special protocol for talking out the keypad connection to currently-undefined devices.

There is space for an RJ11-type connector and internal modem under the Vector Pad. Just connect your phone line, and go. The modem can also turn the machine on to receive a call. We're working on a 2400 baud data, 9600 baud FAX modem.

Incidentally, because of the very small and light connectors used, we've provided mounting points so you can anchor a peripheral onto the machine. That way, it doesn't put a strain on the connector itself.

AE: Which version of TOS comes in the ST Book?

TH: TOS 2.06, one of the latest and greatest. We've added a couple of features: for example, if you hold down the Control key during the boot procedure, it loads the hard disk driver as normal, but it does not run desk accessories or the \AUTO folder, or load the NEWDESK.INF file. This is in case you have a bad desk accessory, \AUTO folder program, or NEWDESK.INF, and you can't get your system up. It allows you to bypass the corrupt files and get your machine running.

TOS and the ST Book ROMdisk, which contains the file transfer software and such, are contained in one 256K x 16 ROM chip one half inch on a side. It's very easy to change — pop out the ROM, pop in a new one, and you're done.

AE: Other than TOS, what is in the ROM?

TH: The power control software that allows you to do a Save and Resume, the file transfer software, and something called "Book Format."

We provide Book Format, in case the data on your hard disk becomes corrupted. It formats and partitions the internal hard drive, and installs a bootable driver. Just run the file transfer program to put files back onto your machine.

The hard disk comes with a calendar and calculator, which run as accessories. You also get a floppy containing the Control Panel and CPXs, and the accessories, should you need it.

AE: ST Book comes with a calendar/appointment program. How does it work?

TH: The real-time clock chips in STs and STes have had an "Alarm" output, which previously hasn't been connected anywhere. In the ST Book, it's actually connected to the power-on circuitry.

You can set an alarm for sometime in the future that will turn on the system. The system will go right back to whatever application you were in, and then things like desk accessories and such can run. Programs can use that capability; for example, software could wake up the system, use a modem to call a bulletin board, download a couple of files, and go back to sleep. We've provided a new system call to allow them to do things like that.

The calendar program keeps track of appointments and regularly scheduled events, and has a phone dialer and such. When one of its alarms go off, it turns on the machine, beeps, and displays an Alert Box with the text you entered for that particular appointment.

AE: Will all ST Books have hard disks?

TH: Yes, they will have at least forty megabyte hard disks. There could be some available with sixty megabyte and larger drives.

AE: Could a dealer install a larger capacity hard drive?

TH: Yes, but it would take some work. We don't recommend you buy other IDE drives, because there are some characteristics about the ones we're using, various features that we've had put into the firmware, which aren't on standard IDE drives. Other IDE drives will work, but you won't get as careful power control.

AE: The entire ST Book is smaller than an ST keyboard, so a new keyboard was obviously needed. How did you fit a workable ST keyboard into that space?

TH: This keyboard has eighty-four keys, rather than the ninety-four of a full size keyboard. The keys are slightly closer together than on a full-size keyboard, and have a shorter keystroke, but the difference is small enough that it's really quite easy to use.

The keypad keys are embedded into some of the normal keys; there's a "Fuji" key, which allows you to access the "keypad" modes in the normal keyboard. There's also a "Pad Lock" key to lock the keys into that mode. It gives you a numeric keypad within the regular keyboard.

We also added a couple of features to the keyboard controller. It now has a "sleep" capability, where the controller can go to sleep between keystrokes or commands, saving a little more power. That requires hardware handshaking between the keyboard and the

rest of the machine, which is built into the ST Book. One side effect is that on the ST Book, you don't lose keystrokes if software can't keep up; they'll just be saved up in the keyboard controller until it can send them out.

AE: Without a floppy drive, how do you transfer files into the ST Book?

TH: You can use the built-in file transfer software and the parallel port; it takes about two minutes to transfer a megabyte of data.

We include a special file-transfer cable, which is a parallel printer cable with a couple of pins swapped, and a copy of the file transfer software on floppy disk, so you can run it on another ST. The software shows you both machines' disks. You select files to copy, and copy to or from the other machine; you can do backups in either direction, all over the parallel port. It will also work over the serial port, so if you don't happen to have the parallel file transfer cable with you, you can use a serial cable. We have available a Portfolio version of the program as well, which will allow you to transfer data with a Portfolio.

AE: What about those who really want a floppy drive?

TH: We will make an external, battery operated, high-density floppy. It should provide over two hours of active use on four alkaline cells — much longer if it's off much of the time. The drive won't steal power from the ST Book's batteries, but if the ST Book is plugged into its AC adapter, the floppy drive will get power from that. Otherwise, the drive has its own AC adapter.

AE: Is the drive different from other ST external floppy drives?

TH: Yes. To save power and space in the ST Book itself, the floppy drive controller chip is in the floppy drive. It's a new chip, which allows us to use a high-density, 1.44 megabyte drive, the only drive planned for the ST Book.

AE: ST Book allows you to shut it down quickly, even within an application, and come back right where you were, a feature called "Save and Resume." How is that done?

TH: What actually happens is the machine reads the values of all its hardware registers: processor registers, hard drive, memory control, video access mode, video base registers, everything it can find, and stores them in a previously-allocated section of memory. In ST Book, all the memory is always battery-backed; it's not a special bank.

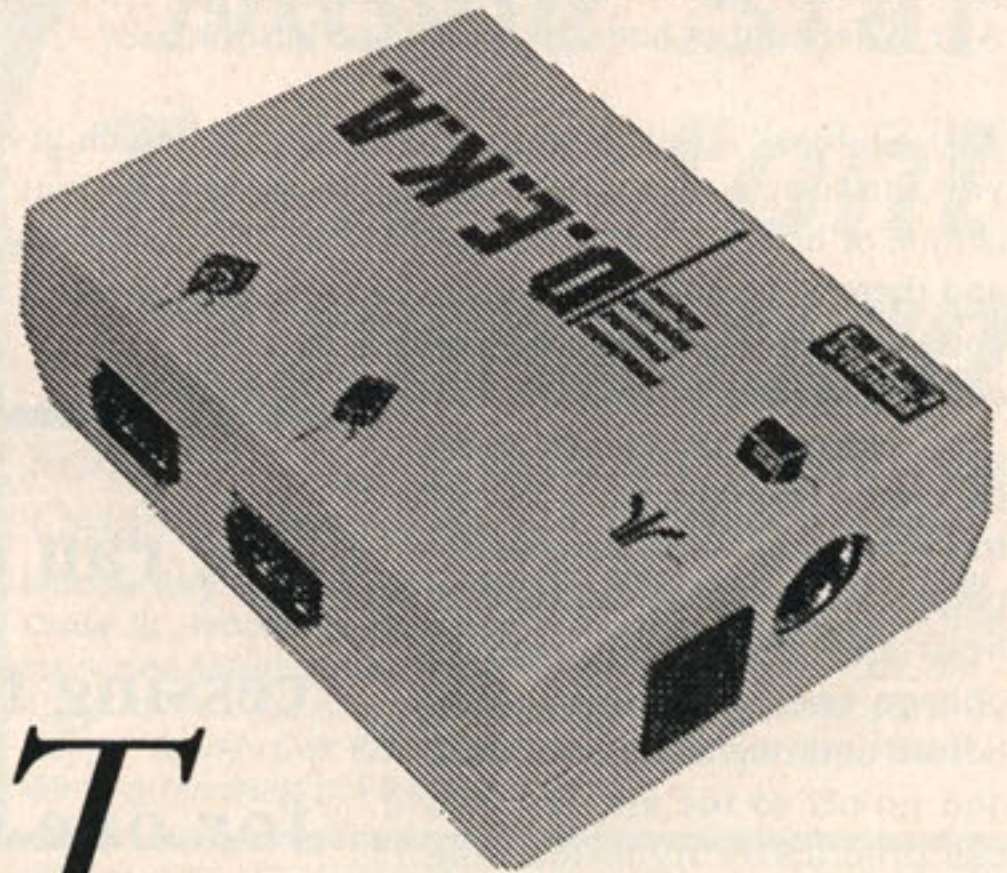
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executes a routine to restore the machine to the state it was in before it was shut down. It restores the registers, then the BIOS returns the machine to your code, as if nothing had happened. It all takes about a half a second — even if you need to spin up the hard drive to save a file, that only takes about three seconds.

It works in almost all applications, unless they're doing weird networking over the MIDI port or something like that. The vast majority of programs like spreadsheets or word processors have no problems at all.

AE: What kind of batteries does the ST Book use?

TH: ST Book is designed to run on NiCads, which give you the long battery life. Alkalines only give you a couple of hours of battery life, but if you're at an airport and there's no place to plug in, you can buy yourself a couple of packs of batteries and continue working.

It's unlikely you're going to need a recharge in a day of travel anyway. With two battery packs, which charge in about an hour and a half, it's easy to charge one pack the evening before and one in the morning, and go off to the airport; you can practically fly around the world on two packs.

AE: Are the battery packs recharged when they're in the machine?

TH: They're recharged in the machine whether the it's running or not. It's an independent portion of the AC adapter.

AE: An hour and a half charging gives you five hours of use?

TH: That's absolute minimum. We ran tests here, accessing the hard drive for one minute every five minutes, displaying a fairly complex dither pattern on the screen, and using no power saving techniques at all, and we got over five hours of battery life. During normal use, I would expect ten hours.

Save and Resume saves a great deal of power. And when you shut the machine down, it uses so little power battery-backing the memory, the bat-

teries will last up to three months.

AE: What power-saving techniques are available?

TH: There are three things you can do. "Video Saver," stops updating the LCD display from main RAM; the LCD controller has its own copy of screen memory, and it updates the LCD from that. Whenever a system call is made to update the screen, screen updates are turned on, and turned off afterwards, automatically.

The side effects of this are minor. Because screen updates aren't being done from RAM, we have to turn on some self-refresh circuitry to keep the RAMs refreshed, which slows down memory accesses every once in a while. Programs run 0.5% slower in this mode, and for the cost of that 0.5%, you save twenty to twenty

five percent of the system power — a very good tradeoff. If you have some weird program that writes to screen memory directly, one that doesn't use system calls, there's no way to detect that, and the changes it makes to the screen won't show. But those programs work fine with Video Saver off.

After a certain amount of time, "Blank Screen" turns off the voltage to the LCD driver, saving another ten to twenty percent of the system power. Its only side effect is blanking your screen. Whenever there's a key-stroke, or if you choose, activity on the serial port, it turns the screen back on.

If there's no physical I/O, meaning any kind of floppy, hard drive, serial, parallel, MIDI, or keyboard activity for a certain amount of time, "Shut-down" shuts off the system via Save and Resume. When you press the Power button, you're right back where you were. Both Blank Screen and Shut-down are programmable for up to twenty minutes delay.

AE: No matter how thrifty you are with battery power, they'll run out eventually. Can you monitor their condition?

TH: There's a lot of power detection and management built into the machine. There are actually three levels of low power

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—Tracy Hall

signals: Source Low, Source Dead, and Power Not Good. The Power light is green under normal conditions, orange when the battery is low, and red when "Source Dead" occurs. There's also a bit that can be read by software, indicating that the batteries are low.

When the light turns orange, it usually means you have about a half an hour left in the batteries; it's a darned good idea to save your files and find an AC source or a fresh battery pack, particularly since all you have to do is hit the power button to turn the machine off, swap in a new battery pack, and turn the machine on again.

Both the Source Low and the Source Dead signals allow code to run. Power Not Good means the five volt supply to the machine is drooping, and shuts down immediately. You will probably never actually see the red light; by the time it's red, the machine's shut off.

AE: In the worst case scenario, what could happen if you let the batteries run dry, and ignore all the signals?

TH: You might have to reset the machine, but you most likely won't lose anything. The ST Book takes care of itself pretty well. If you don't try to "push the envelope," it will survive.

AE: When Source Dead has occurred, is the data in memory preserved?

TH: RAM is maintained, as a matter of fact. It has a separate linear power supply, which works off the NiCads until they get down below about six volts, which for eight NiCad cells is really low. Then there's a pair of rechargeable lithium cells to take over, which allow you to switch battery packs; they keep RAM alive for forty or fifty hours, so you can switch batteries r-e-a-l s-l-o-w-l-y.

AE: What about the hard drive?

TH: These hard drives are quite good at taking care of themselves — they automatically park their heads, so they won't be damaged.

AE: What kind of battery packs does ST Book use?

TH: They're about cigarette case size, and the NiCad packs weigh about a half pound to a pound, and give very good power density.

There's also an alkaline pack; you just drop your batteries into the pack, and slide it into the machine. ST Book only charges NiCads, so if you plug in the AC Adapter/Recharger while you have alkalines in, the machine will stop using power from them and won't try to recharge them. It's perfectly safe. ■

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