XEROX
PALO ALTO RESEARCH CENTER
Systems Science Laboratory
LSI Systems Area
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To: NoteTaker Interest Group

From: Doug Fairbairn

Subject: Subsystems Analysis: NoteTaker I

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This report is the collection point of all moans, groans, and gripes about the NoteTaker I system. If there is something you want changed about the current NoteTaker design, be it physical or electronic, and it isn't on this list, please send a message to "Resnick" (cc: Fairbairn) immediately. Updated copies of this report will be available periodically. Comments are surely encouraged.

I. NoteTaker System

A. Physical characteristics

1. Size: 7" x 14" x 22" (2107 cu. in.)
2. Weight: 40.5 lbs. w/o batteries; 48 lbs. w/ batteries
3. Power Consumption:
   a. +36v: ???
   b. +43v: 400 ma.
   c. +12v: 2.65 amps (31.8 watts) w/ disk running
      1.3 amps (15.6 watts) w/o disk running
   d. +5v: 7.8 amps (39 watts) w/ disk running
      7.3 amps (36.5 watts) w/o disk running
   e. -20v: ???
4. Chip count: 387 including memory
   307 logic only
5. Cost: $8700.00 or so...

B. What's wrong

1. Chips can fall out of board sockets

2. Can't plug boards into machine with power on.

3. The timing and loading of the system bus needs to be evaluated.

4. There is currently no serial number wired into the NT. On the Alto, this was taken care of by wire-wrapping on the backplane. We don't have enough spare pins on the NoteTaker. What should we do??

5. Power consumption numbers need to be verified.

C. What's right

D. Debugging problems

a. Field Maintenance

b. Untrained personnel

c. Test point accessiblity

d. Signature ananlysis?

E. Possible changes for NT2

1. New housing

2. Solder in 2 pins of each chip?

3. Use in-board socket pins?

4. Increase maintainability

II. Emulation processor

A. Physical characteristics

1. Size: 8.8" x 5.8" x 0.6" (30.6 cu. in.)
2. Weight: 12 oz.
3. Power Consumption:
    a. +5v: 900 ma. (4.5 watts)
4. Chip count: 56
    a. Processor and support:
    b. Boot interface logic:
    c. Local memory control logic:
    d. Parity error detection logic:
    e. Local memory: 16 chips
    f. Main memory control logic:
5. Cost: $624.00

B. What's wrong

1. Too big, too much power
2. The parity error flip flop can be reset by any good read of data.
3. Can the LEDs be used to better advantage?
4. The LEDs are not on a visible edge of the board.
5. The illegal address sensor may cause an interrupt too late and will not work if there are other interrupts pending at the same time. Its output needs to be latched.
6. The design must be tested at 8 Mhz. to see if there are problems at this speed.
7.

C. What's right

1. Basically works.

D. Debugging problems

1. Doesn't have its own ROM so it requires a different debug board from the IOP.
2. ROM overlaps the address space in funny ways.

E. Possible modifications for NT2

1. TRy to get memory control logic into hybrid chip and put 2 processors on one

board.

2. Use 4816 style chips to allow EPROMs and RAM to be mixed.

3. Put PPI on board with 2 processors and allow either to talk to it. This would mean no external debug board.

4. Do away with parity error logic if 2k x 8 RAMs are used.

III. IO Processor Module

A. Physical characteristics

1. Size: 8.8" x 5.8" x 0.6" (30.6 cu. in.)
2. Weight: 12 oz.
3. Power Consumption:
    a. +5v: 1500 ma. (7.5 watts)
    b. -20v:
    c. +12v:
4. Chip count: 58 dips
    a. Processor/support: 10 chips
    b. External interface: 0.5 chips
    c. Boot logic: 4 chips
    d. External memory control: 16 chips
    e. Local memory control: 7 chips
    f. Keyboard interface: 5.0 chips
    g. DAC: 10 chips = 22 discretes
    h. Tablet drivers: 0.5 chips + 12 discretes
    i. Voltage regulators: 3 chips
    j. Misc.: 1 chip
5. Cost: $602.00

B. What's wrong

1. Too big, too much power
2. Reliability of power-on reset needs to be verified.
3. Can the ROM be left in high memory?
4. Can the keyboard UART be combined with the EIA UART
5. The DAC/S/H is too noisy
6. The DAC amplifier is not really optimized yet.
7. The output of the DAC needs a better filter
8. Are the voltage regulators doing OK? Are they overloaded?

9. Is the way the stereo is controlled on the S/H the proper method? Can we do better?

10. Do we need more or less control over the speed of the DAC?

11. We would like to have a PPI type output from the IOP.

12. Board is too congested.

13. One of the regulator chips has too large of heat sink and this interferes with neighboring boards.

14. The speaker should be a 45 ohm model so the low end frequency response is better.

15. Does not work at 5 mhz.

16. The disk controller is the item which limits the speed of the current local memory operations. This seems to be a waste in that the other things will run much faster. This will be even truer in the future when high speed EPROMs become available. We need to see if we can separate the timing of the i/O subsystem from that of the memory operations or perhaps get selected WD1791s or ????

C. What's right

1.

D. Debugging problems

1. How should we include signature analysis techniques?

2. What test points can be added to improve diagnosis?

E. Possible NT2 plans

1. May combine with EP

2. PPI on board

3. Hybrid module for memory control

IV. Disk/Display Module

A. Physical characteristics

1. Size: 8.8" x 5.8" x 0.6" (30.6 cu. in.)

2. Weight: 12 oz.

3. Power consumption:

a. +5v: 1400ma. (7.0 watts)

b. +12v:

c. -5v:

4. Chip count: 60

a. General support: 7

b. Disk Interface: 6 + 9 discretes

c. Display interface: 33

d. A/D converter: 7 + 7 discretes

e. EIA interface: 7 + 7 discretes

5. Cost: $512.00

B. What's wrong?

1. Double density operation has not been proven yet.

2. Power switching to disk causes glitches - relays are a problem.

3. Don't have control over motor on without modifying disk drive.

4. Is the display controller the best we can do?

5. Speed range adequate on A/D converter?

6. Is noise a problem on A/D convereter?

7. Can the same UART be used for the EIA interface and the keyboard interface?

8. Board is too congested

9. Too big, too much power.

10. Method of getting around false address select is a bit flaky on the display controller

C. What's right?

1. Seems to fulfill basic functions

D. Debugging problems

1. Should it be possible to debug without processor attached?

2. What test points can be identified which will ease debug?

3. How can signature analysis be used effectively?

E. Possible NT2 modifications

1. LSI the display controller?

2. Combine the EIA interface and the keyboard interface into one UART.

3. Make the keyboard interface a true RS232 port with proper levels going out. the keyboard itself could still genereate standard TTL levels but its input would have to be modified slightly to accept EIA levels coming in.

4.

V. Memory Control module

A. Physical characteristics

1. Size: 8.8" x 5.8" x 0.6" (30.6 cu. in.)

2. Weight: 12 oz.

3. Power consumption:

a. +5v: 1900 ma. (9.0 watts)

4. Chip count: 67

5. Cost: $409.00

B. What's wrong?

1. Too big, too much power

2. Does not seems to run smoothly over wide frequency range.

3. Have not proven error logging.

4. Is it as fast as it could be?

5. Error correction w/ procesor still needs to be checked.

6. Can't write bad syndromes to check error correction logic.

C. What's right:

1. Seems to work OK at 17 mhz.

D. Debugging problems

1. Timing is too complicated.

2. Need to identify test points or some special tools to aid debug. (signature analysis?)

E. Possible changes for NT2:

1. Reduce size/power by moving some of the functions to the LSI chip and using F series logic where Shottkey is now.

2. A total redesign may be necessary to simplify and make it compatible with LSI chip.

VI. Memory Data module

A. Physical characteristics

1. Size: 8.8" x 5.8" x 0.6" (30.6 cu. in.)

2. Weight: 12 oz.

3. Power consumption:

a. +5v: 980 ma. (4.9 watts)

4. Chip count: 48

5. Cost: $346.00

B. What's wrong?

1. Too big, too much power

2. Is it as fast as it could be?

3. Error correction w/ procesor still needs to be checked.

4. Can't write bad syndromes to check error correction logic.

5.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1. Replace with LSI chip.

VII. Memory Storage module

A. Physical characteristics

1. Size: 8.8" x 5.8" x 0.6" (30.6 cu. in.)

2. Weight: 12 oz.

3. Power consumption:

a. +5v:

b. +12v:

c. -5v:

4. Chip count: 49

5. Cost: $963.00

B. What's wrong?

1. Can't accept 64K chips

2. Too much power in driver chips

3. We are finding a large number of bad chips

C. What's right:

1. Seems to work OK.

D. Debugging problems

1. We need to think about the debugging problems with the on-board error correction.

E. Changes for NT2:

1. Lay out new board to accept on-board error correction and 32K/64K chips.

VIII. Mother board

A. Physical characteristics

1. Size: 7.2" x 5.8" x 0.6"

2. Weight:

3. Power consumption:

a. +5v:

4. Chip count: 0, 2 discretes

5. Cost: $121.00

B. What's wrong?

1. Cabling to and from is awkward

2. Not held securely in place

3. Connectors do not hold modules as securely as they might.

4. The display connector tongue was not cut accurately.

5.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1. Replace with board which has pin out in all sockets the same.

2. Perhaps allow some of the front panel controls to be soldered directly to the board.

3. Should we rearrange some signals to reduce noise or get power lines away from signal lines?

4. Replace current connectors with deeper ones.

5. Arrange a method to align cards before they go into slot so they may be plugged and unplugged with power on.

6. Make it so the power is connected to the board through a connector instead of lugs. This will make harness and system assembly easier and will reduce assembly errors.

IX. Battery module

A. Physical characteristics

1. Size: 8.8" x 5.8" x 2.6" (132.7 cu. in)

2. Weight: 7 lbs. 12 oz. (?)

3. Power capacity:

a. 28.8v: 4.0 amp-hours

4. Chip count: 0, 15(?) discretes

5. Cost: $300.00

B. What's wrong?

1. You can short out the battery terminals

2. The battery charging circuit needs to be analyzed for correctness. There is at least one resistor with the wrong wattage rating.

3. Need to look at alternative of clipping it to outside of package.

4. Current battery life is not as great as expected.

5.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1. Possibly make battery pack an external package.

2. Modify charging circuits?

X. Keyboard

A. Physical characteristics

1. Size: 14.5" x 5.0" x 1.5" (108.8 cu. in.)

2. Weight:

3. Power consumption:

a. +5v:

4. Chip count: ?

5. Cost: $277.00 (?)

B. What's wrong?

1. Does not use the most optimum type of keyboard switch.

2. Has too much discrete logic

3. Keys tend to bind.

4. Seem to lose mouse samples at high speed.

5. Use of connector is not obvious

C. What's right:

1. Seems to work OK.

D. Debugging problems

1. Not too bad.

E. Changes for NT2:

1. Get rid of UART.

2. Use new type of power-switched keyswitch.

3. Reduce chip count.

4. Consider use of telephone type connector.

XI. Power Supply

A. Physical characteristics

1. Size: 8.5" x 6.4" x 3.8" (206.8 cu. in.)

2. Weight:

3. Power :

a. +5v: 8.0 amps

b. +12v: 4.5 amps

c. -20v: 400 ma.

d. +43v: 400 ma.

4. Cost: $525.00

B. What's wrong?

1. Too expensive.

2. Too heavy

3. Too many internal fuses which are hard to get to.

4. Can't adjust all pots from the accessible side.

5. Do we need 400 ma. from the -20v or could it be reduced?

6. Are the other specs OK?

7. Can the switching noise on the output be reduced?

8. Can we reduce inter-board connections even more?

9. Needs better cooling/heatsinking.

10. Reliability?

11. The output connections should be through a single connector, not through many different screw terminals. The connector would make power supply replacement simple and foolproof.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1. Get rid of a lot of metal work in case

2. Increase heat sink area.

3. Modify to fit in new housing.

XII. Display

A. Physical characteristics

1. Size: 8.0" x 6.5" x 6.5" (338 cu. in)

2. Weight: 4.0 lbs.

3. Power :

a. +12v: 900 ma. (10.8 watts)

4. Cost: $277

B. What's wrong?

1. There is a bright line down the left side of the screen caused by some ringing in the yoke. They have agreed to fix this but have not yet done so.

2. The CRT noise problem.

3. The fuse seems to blow too often.

4. We need to settle on what the best interface is for the video signal to the monitor. The set of resistors which are currently used are not necessarily optimal.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1. Fix yoke ringing and CRT noise problems.

XIII. Floppy disk

A. Physical characteristics

1. Size: 5.75" x 3.25" x 8.0" (149.5 cu. in.)

2. Weight: 3.0 lbs.

3. Power :

a. +5v: 500 ma.

b. +12v: 1.35 amps

4. Cost: $450.00

B. What's wrong?

1. Too expensive.

2. Haven't tested the double-headed, double-density drives yet. Verify operation of data separation circuit.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1.

XIV. Package

A. Physical characteristics

1. Size: marginal

2. Weight: far too much

3. Cost: far too much

B. What's wrong?

1. Include Bobby's list.

C. What's right:

1. Looks beautiful

D. Debugging problems

E. Changes for NT2:

1. Total re-engineering of case.

2. Make battery module a separate package

3. Cost target: < $500.00

4. Weight target: < 7 lbs.

XV. Mouse

A. Physical characteristics

1. Size: 3.3" x 2.2" x 1.3" (9.5 cu. in.)

2. Weight:

3. Power :

a. +5v: ?

4. Cost: $260.00

B. What's wrong?

1. Too expensive.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1. Do not anticipate any changes.

XVI. Tablet

A. Physical characteristics

1. Size:

2. Weight:

3. Power :

a. +5v: ?

4. Cost: $?????

B. What's wrong?

1. Unproven manufacturing technology

2. Reliability

3. The interconnecting cable is too fragile

4. May be too noisy

5. Non-linearity

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1.

XVII. Cabling/harnesses

A. Physical characteristics

1. Size:

2. Weight:

4. Cost: $180.00

B. What's wrong?

1. Too tricky to assemble

2. Too prone to error

3. The more wires there are, the more wires there are to get broken.

C. What's right:

1. Seems to work OK.

D. Debugging problems

E. Changes for NT2:

1. Simplify

LISTED BELOW ARE SOME AREAS WITHIN NOTETAKER PROTOTYPE UNIT THAT REQUIRE MODIFICATIONS, IMPROVEMENT, ELIMINATION, ETC:

MOST OBJECTIONABLE FEATURE IS THE WEIGHT OF THE TOTAL PACKAGE, 45 LBS (INCLUDING THE 7 LBS 9 OZ BATTERY MODULE). ENCLOSURE , AS SUPPLIED BY INOVA WITH MISC. BRACKETS & ANGLES, WEIGHS 17 LBS 12 OZ. OUR DESIRED WEIGHT GOAL IS BETWEEN 8 LBS TO 12 LBS MAX. AND COST PER ENCLOSURE ASSY @ $500.

TO ACHIEVE THIS GOAL OTHER METHODS, MATERIALS MUST BE CONSIDERED AND EVALUATED:

1) ONE PIECE SHEETMETAL (ALUMINUM) BASE STRUCTURE FOR MOUNTING ALL ELECTRO-MECHANICAL EQUIPMENTS AND TOP AND BOTTOM SKIN (ABS VACUMN FORMED OR ALUMINUM SHELL OR OTHER), BASE STRUCTURE MUST TRANSFER EQUIPMENT WEIGHT DIRECTLY TO CARRYING HANDLE.

2) ONE PIECE FRONT PANEL WITH PROVISIONS FOR MOUNTING OF CONTROLS, CRT HINGE AND DETENT, MINI-FLOPPY & DISKETTES STORAGE, ELIMINATING THE SEVERAL PIECES OF BRACKETS PRESENTLY USED.

3) KEYBOARD SHELL OF VACUMN FORMED ABS MATERIAL WITH BONDED BOSSES AND KEYBOARD PANEL OF LIGHTER GUAGE ALUMINUM SHEET.

OTHER AREAS THAT NEED READDRESSING ARE:

1) AIRFLOW NEEDS TO BE INCREASED WITH EITHER PERFORATIONS OR LOUVERS THAT WILL ALLOW MORE AIRFLOW FOR HEAT DISSIPATION. *(REDESIGN)*

2) UNIT WEIGHT TRANSFER TO CARRYING HANDLE THROUGH KEYBOARD PANEL OBJECTIONABLE AND STRUCTURALLY NOT IDEAL. *(REDESIGN)*

3) CARRYING HANDLE SIZE AND CONTOUR VERY UNCOMFORTABLE FOR TRANSPORTING UNIT FOR ANY DISTANCE. *(REDESIGN)*

4) RESET BUTTON CAN NOT BE ACTIVATED WTIH THE FINGER TIP *(ENLARGE CLEARANCE HOLE).*

5) REAR CONNECTOR PANEL NEEDS REALIGNMENT, SOME CONNECTOR SLOTS 180 DEGREES OFF. PANEL ALSO NEEDS TO BE TRIMMED, HOLES SLOTTED TO FIT IN SPACE ALLOCATED

6) CRT BEZEL DOESN'T HAVE A GOOD HANDLE, SMALL RUBBER BUMPER NOT THE SOLUTION.
(DESIGN FINGER GROOVE IN MOLDED BEZEL)

7) REAR FIBERGLASS COVER NOT FABRICATED TO FIT IN SPACE ALLOCATED CAUSING IT TO BIND WITH SIDE OF POWER SUPPLY. *(REDESIGN)*

8) MOUNTING ANGLES AT REAR OF UNIT NOT PROPERLY LOCATED TO ALIGN WITH REAR MODULE COVER, CONNECTOR PANEL, AND POWER SUPPLY. *(MOUNTING LOCATIONS IMPROPERLY DIMENSIONED - USING MORE THAN ONE DATUM LINE ON DETAIL DRAWING)*

9) PW BOARD ALIGNMENT NEED SIMPLIFICATION. *(PROPOSE A 1 PIECE INTEGRAL CARD CAGE WHICH FASTENS TO BASE STRUCTURE).*

10) KEYBOARD & HANDLE MECHANISM ASSY METHOD ALLOWS LIMITED ACCESS TO HARDWARE WITH ANY TOOL, ALSO ALIGNMENT OF THE KEYTOPS TO TOP PANEL SHOULD BE SIMPLIFIED.
(PROPOSE KEYBOARD PW ASSY BE ALIGNED & MOUNTED TO BOSSES PROVIDED ON KEYBOARD PANEL).

11) SORENSEN POWER SUPPLY WEIGHT OF 6 LBS 12 OZ IS TOO HEAVY.
(PROPOSE LIGHTER GUAGE MATERIAL FOR HOUSING AND MTG ANGLES AND ELIMINATING EXCESS SHEET METAL).

12) MOUNTING HARDWARES FOR CRT & TABLET INSTALLATION TO BEZEL DIFFICULT TO GET TO. *(PROVIDE EASIER EXCESS TO HARDWARE).*

13) REMOVAL OF THE TOP COVER REQUIRES REMOVAL OF HARDWARES AT 10 DIFFERENT LOCATIONS, (4 RUBBER FEET ON BOTTOM, 4 RUBBER FEET ON REAR OF UNIT, AND 2 C'SK SCREWS THROUGH CONNECTOR PANEL). *(SIMPLIFY ASSEMBY, DISASSEMBLY).*

14) ADEQUATE CLEARANCE NOT PROVIDED BETWEEN THE REAR OF CONTROLS AND THE MOTHERBOARD CONNECTOR PINS PROTRUDING THROUGH THE BOARD. *(LOCATE MOTHERBOARD FURTHER AWAY FROM THE REAR OF CONTROL PANEL).*

15) INSTALLATION OF SWITCH AND KEYBOARD CONNECTOR RECEPTACLE THROUGH PROVIDED NICHE IS VERY PAINSTAKING. *(REDESIGN SUBPANEL TO MAKE INSTALLATION OF CONTROLS AND CONN RECEPTACLE SIMPLER).*

16) THE POSITION OF THE MOUSE HOLE FORCES THE OPERATOR TO PUT MOUSE FAR TO THE RIGHT OF KEYBOARD WHEN IN OPERATION. *(STUDY ALTERNATIVES)*

17) SPEAKER SHOULD NOT BE ON REMOVABLE PART OF HOUSING. *(INSTALL SPEAKER IN MAIN STRUCTURE).*

18) CASE IS TOO EASILY SCRATCHED. *(MOLDED IN COLOR, BETTER PAINT).*

19) MOTHERBOARD CONNECTOR NOT DEEP ENOUGH FOR GOOD PWB CONNECTIONS AND RETENTION. *(REPLACE PRESENT VIKING CONNECTORS WITH DEEPER AMP TYPE CONN., THIS WILL REQUIRE REDESIGN EFFORT ON PW BOARDS).*