PEN
Personal Electronic Notebook

Jacob Shaha

Clark Coulam

Neal Tew

Abstract

- Design a system to replace loose-leaf notebooks in school and the workplace.

- Paper notebooks offer incredible flexibility, but are environmentally wasteful and become difficult to store after a prolonged educational or occupational career.

- Our system will incorporate current display and interface technologies to provide a writing surface as intuitive and useful as paper, with electronic storage and processing options to simplify use.

What's wrong with paper

- Occupies physical space – storage becomes tough
- Near impossible to develop automatic searching systems
- Environmentally costly

What's right with paper

- Physically resilient
- Can contain any type of information
- Wide viewing angle, ultra-high resolution

PEN Design Objectives

- Durability – physically tough
- Portability – light and convenient size
- Longevity – long battery life
- Viewability – wide angles and brightness
- Applicability – useful for many types of info
- Storage – memory for many "sheets"

Interface

- *Paper* mode for writing and reading
- *Settings* mode for changing unit settings
- *Page browser* for switching internal pages
- *File browser* for moving pages on and off

- Modes are accessed via external buttons; files and menus are accessed on the screen
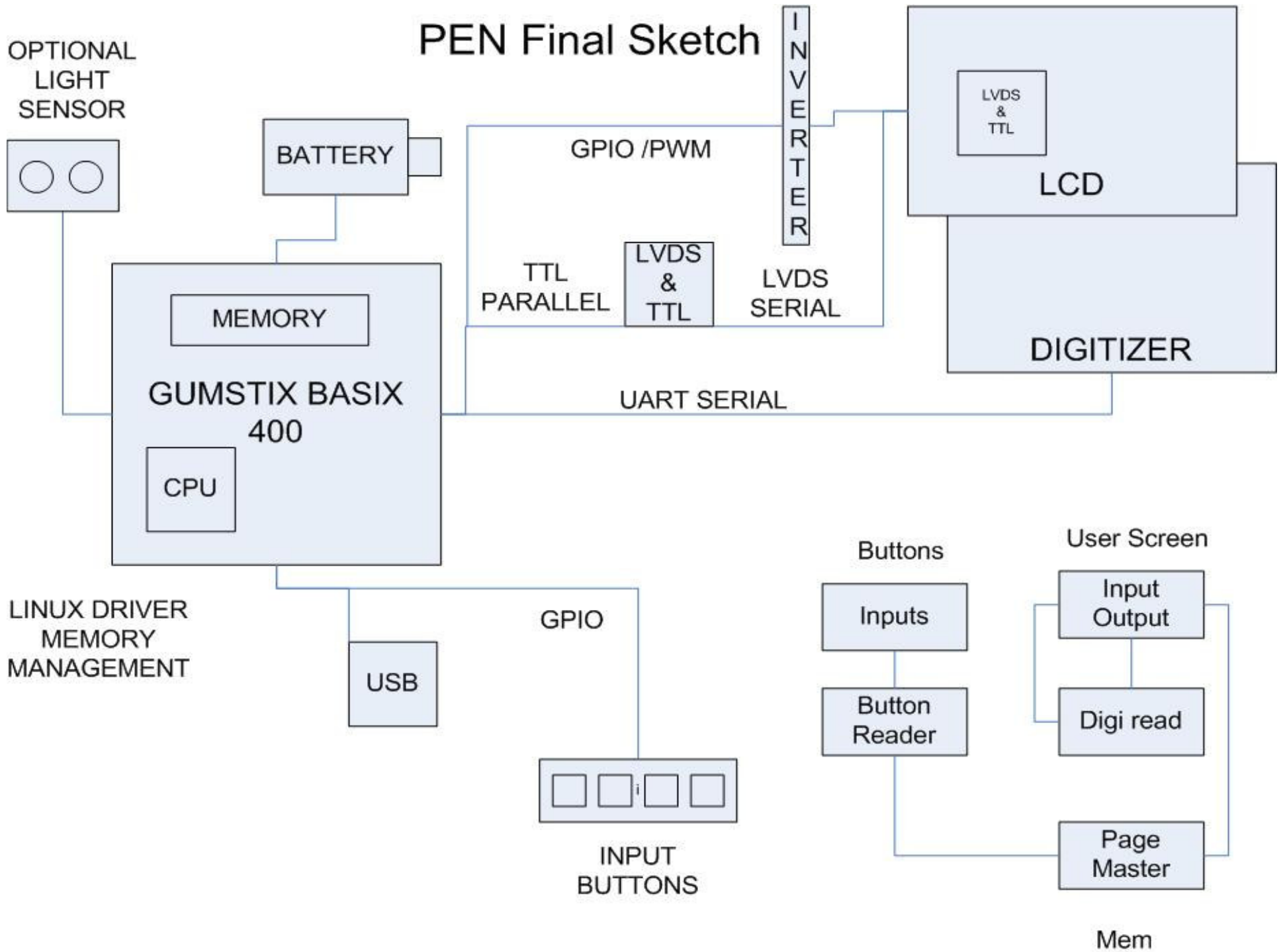
- Aside from the user interface, the PEN will incorporate three well-developed computing solutions:

- Memory management will be performed by an onboard microcontroller, moving information between the screen and internal memory;

- Image encoding algorithms will convert raw screen data into universal file formats, to allow exportation of pages as images;

- Disk management software and hardware will enable movement of page "images" from internal memory to external storage via a USB interface.

Background

- The primary reference work for the PEN is the modern "tablet PC," an adaptation of the notebook computer that uses a touch-sensitive display as the primary user interface.

PEN Final Sketch

OPTIONAL
LIGHT
SENSOR

BATTERY

GPIO /PWM

INVERTER

LVDS
&
TTL

LCD

TTL
PARALLEL

LVDS
&
TTL

LVDS
SERIAL

DIGITIZER

MEMORY

GUMSTIX BASIX
400

CPU

UART SERIAL

LINUX DRIVER
MEMORY
MANAGEMENT

USB

GPIO

Buttons

User Screen

Inputs

Input
Output

Button
Reader

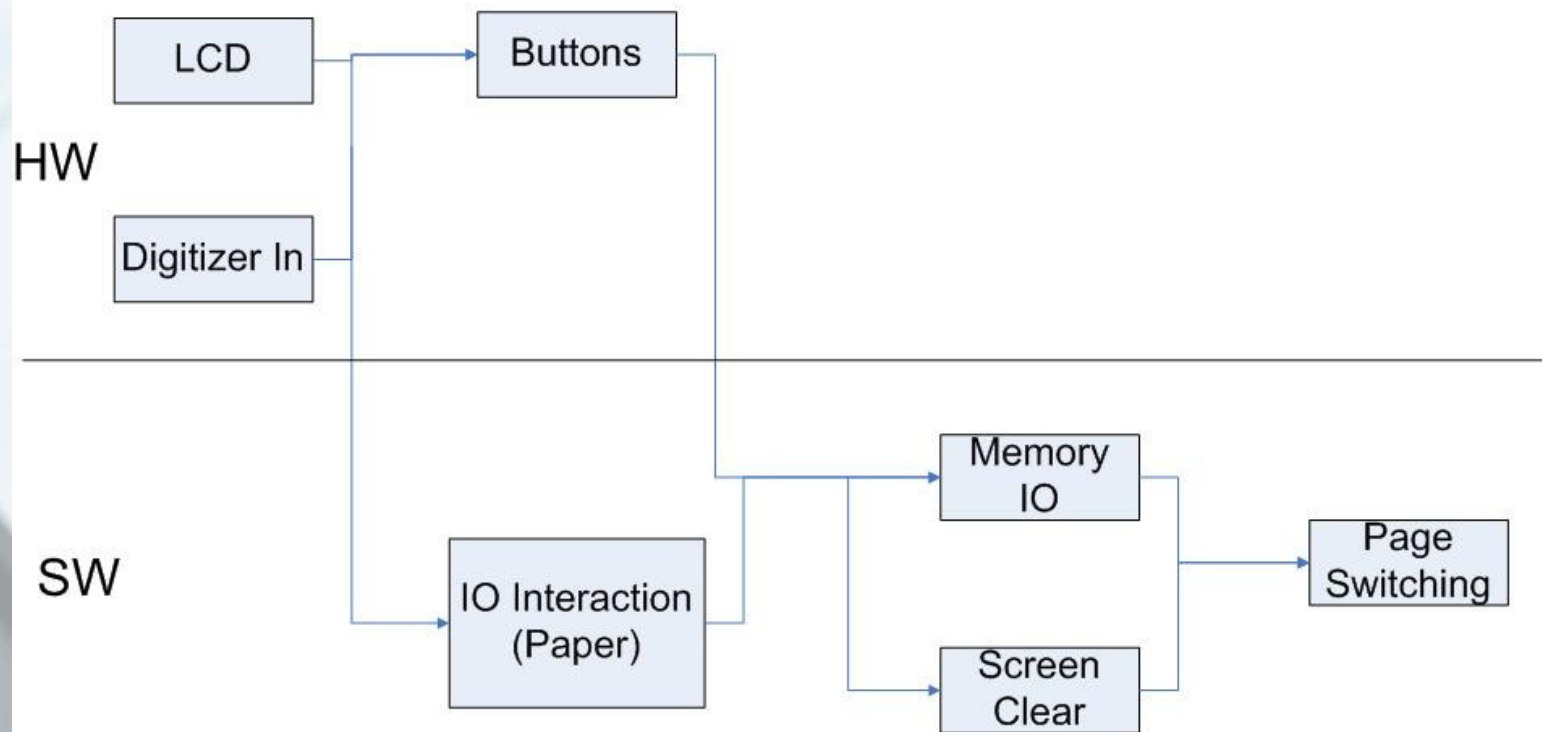Digi read

INPUT
BUTTONS

Page
Master

Mem

Milestones: Alpha

- Contains multiple pages stored in flash memory
- Paper mode functions – stylus can write to paper, sheets can be fully cleared
- Limited settings mode
- Page browser mode
- Deadline: 1 July 2006
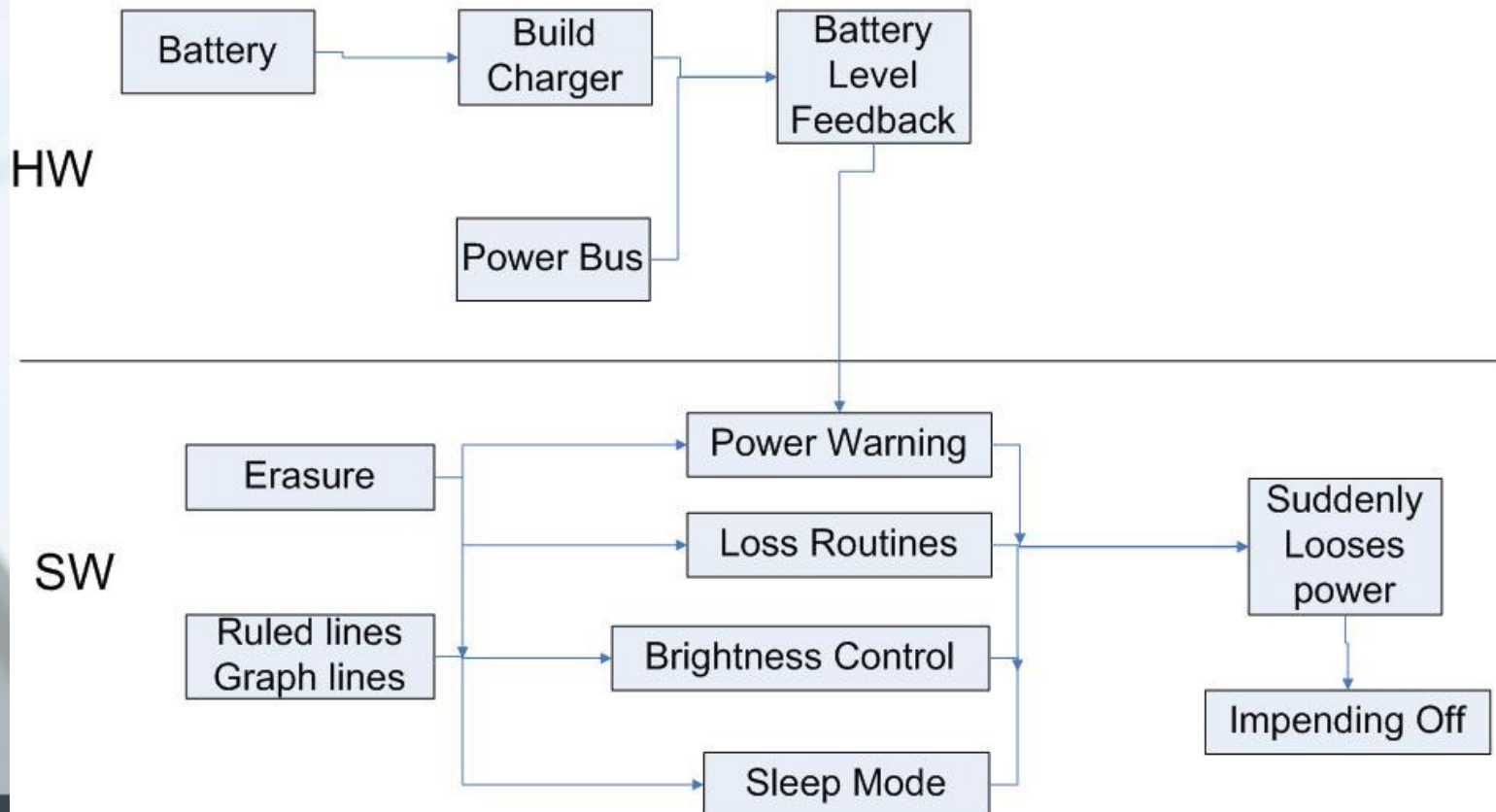
Stage "Alpha"

To be completed by July 1

Milestones: Beta

- Design of 12 V DC power source based on lithium-ion battery
- Eraser input setting
- Power management software
- Deadline: 1 September 2006

Stage "Beta"
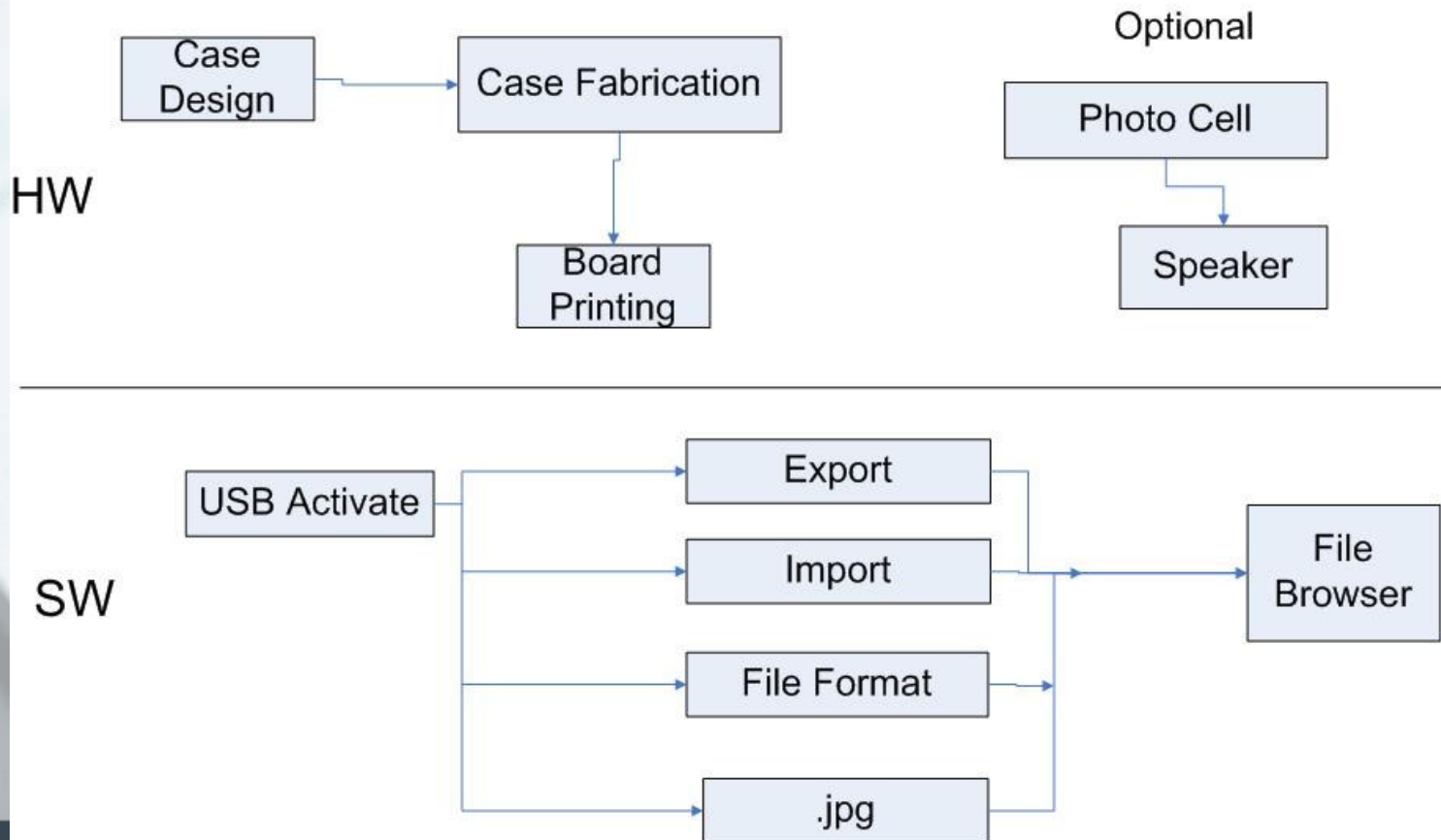
To be completed by Sept. 1

Milestones: Gold

- Image-file encoding
- File browser mode
- Full Settings mode
- USB controller and disk driver
- Plastic case design
- Circuit board fabrication
- Deadline: 1 December 2006

Success Metrics

- Primary concern is **resiliency**: PEN should never, *ever* crash
- PEN should be an attractive alternative to paper for technically-oriented professionals
- PEN should be easy and intuitive enough for my mom to use (and she's awful with tech)

Problems

- LCD / Digitizer interfacing
- GUI development
- Power source design
- Power management algorithms

Finalized BOM

- - HP/Compaq TC1100 LCD Screen and Wacom Digitizing Unit with stylus, approx $150
- - HP/Compaq TC1100 LCD Backlight inverter, approx $40
- - Processor/memory board – Gumstix Basix m400, $150
- - Lead-acid battery, 12 V DC (to be replaced by Li in production), $35
- - USB interface (onboard the Gumstix breakout gs board), $30
- - External buttons
- - Plastic case (to be designed in Gold phase)
- - Nexcom EBK LVDS2 18/24-bit TTL to LVDS LCD transmitter module, approx $60

Testing

- Alpha:
- LCD: can be tested by programming preset patterns into the video memory.
- Digitizer: can be tested by outputting position measurements to the SCI console output built into the m400.
- Input-output coordination: tested by putting pixels at the location of the stylus input
- Page storage: tested by writing to a page, moving to another page, and recalling the previous page

Testing

- Beta:
- Power charging: tested by draining the battery, charging it and measuring incident voltage
- Power monitor: tested by comparing monitor output to analog measurement devices
- Power loss compensation: tested by draining/removing the battery and verifying memory contents following power restoration
- Power management: tested by measuring longevity with and without management algorithms

Testing

- Gold:
- File export: tested by exporting memory contents over USB into a recognizable file
- File import: tested by importing a file and observing a (randomized) pattern of pixels
- File formatting: tested by exporting files that are readable to PC .jpg viewers, and importing .jpg files viewable by the PEN
- File browser: tested by extensive situational file movement scenarios, including destination disk full, read-only, file name conflicts, and other common file system problems
- Page browser: tested by extensive use and monitoring

Summary

- We know what we can do; we left lots of time for things we don't know if we can do
- Job is approximately 85% software, and that suits us just fine
- All of you will want one