Team Gnomes Presents

P38X9-WXZZZ45397ERV.JAS95_MGD

A “Black Box” solution to turning old monitors into digital picture frames

Outline of Presentation

- Team member introduction
- Overview of Project
- Block Diagram
- Major Component Selection
- Packaging Design Specifications
- Circuit Design and Schematic

Introduction

- Egomaron Jegede – Rabbit/Packaging specialist
  - CmpE, graduating 5/2004
- Bill Kreider – IR specialist
  - EE, graduating 5/2004
- Phil Boone – Rabbit specialist
  - CmpE, graduating 5/2004
- Jeff Turkstra – Epson specialist and maniacal team leader
  - CmpE, graduating 5/2004

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Overview of Presentation

- Image data provided via ethernet from a PC is displayed on a VGA compatible device.
  - Data made available via a client program that decodes the JPEG and takes care of communicating with our device
    - Scales image appropriately
    - Adjusts color depth
    - Ensures proper image format
  - VGA display is done via Epson controller interfacing with a 4MB memory chip.
- IR remote control allows product to be placed in a difficult to reach location
  - Allows one to change the picture with just a push of a button!
  - Accomplished with Reynolds Electronics Sony IR decoder and a Sharp IR receiver.

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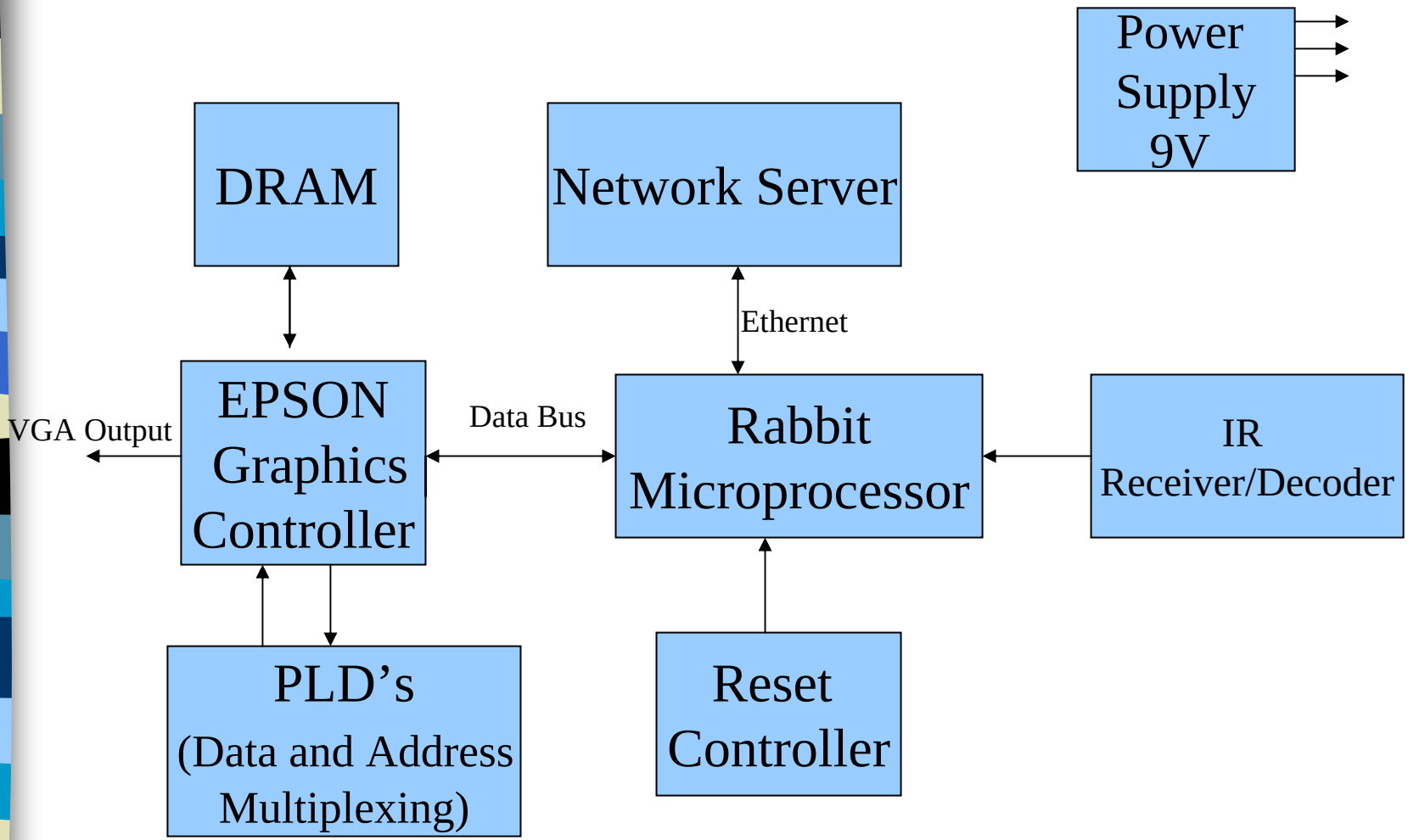
Digital Picture Box Block Diagram



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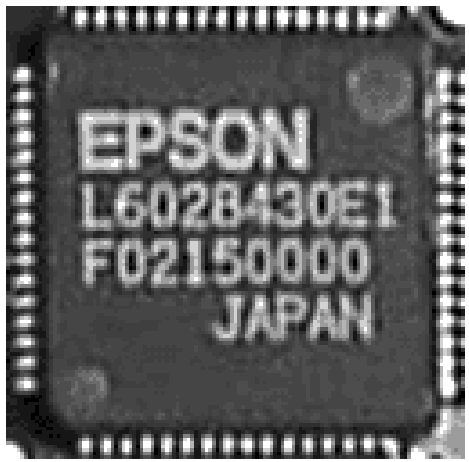
Component Selection Rationale

- Specific Design Constraints Required for the Graphics Chip and Micro Controller
- Comparison of Selected Chips to Alternatives

Required Functionality of the Graphics Controller

- Ability to create and refresh all the analog RGB signals necessary to display an image independently
- Standard DRAM interface for the frame buffer
- Large enough frame buffer size to hold a standard SVGA image

Contestant #1: Epson Embedded RAMDAC LCD/CRT Controller



- Onboard analog RGB output
- Support for external standard EDO/FPM DRAM chip up to 2 megabytes
- Surface mount with 128 pins
- Detailed 500 page technical manual

Contestant #2: Cirrus Logic System-on-a-chip with CRT/LCD Controller

- Onboard analog RGB output
- Support for external standard EDO/FPM DRAM
- Surface mount with 240 pins
- ISA bus, onboard ARM controller, sound output, and PS/2 serial interface

Which graphics controller better suits the needs of our project?

Cirrus Logic

- 240 pins
- Additional features: ISA bus, ARM controller, etc.
- Poor documentation
- External frame-buffer

Epson

- 128 pins
- 500+ page technical manual including timing diagrams, interfacing examples, etc.
- External frame-buffer

Winner? Epson S1D13505

- Additional features of the other chip are not applicable to our project
- Detailed Documentation
- Fewer pins

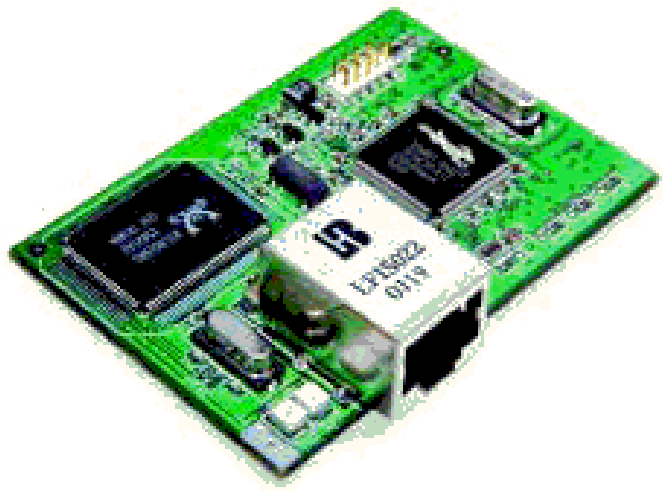
Required functionality of the Microcontroller

- Large number of I/O pins to communicate with the Epson's huge bus(21-bit address, 16-bit data) and an IR chip
- Enough computability to buffer large amounts of data
- Integrated network adapter
- Efficient development environment

Contestants? No contest.

- Due to the network requirement, a Rabbit controller is ideal
- Need a large model to accommodate the I/O pin demand
- High speed required to buffer large amounts of data
- Modest amount of flash memory and RAM to buffer data

Winner? Rabbit 3010 Core Module(based on Rabbit 3000)



- Total of 52 I/O pins(46 pins required for the Epson alone)
- 256kb of Flash Memory
- 128kb Static RAM
- 29.4 Mhz clock

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Packaging Design

- Design Requirements
- Commercial Product Comparison
- Unique/adapted features
- Weight and Cost Estimate

Packaging Design

- Physical Features
  - RJ-45 network connector
  - 15 pin female VGA connector
  - Power and Busy LED’s
  - Push buttons (Next, Previous, Function, Power)
  - Internal electronics :
    Epson , Rabbit ,IR Receiver/Decoder, PLD’s
  - Power input
  - Casing

Commercial Product Analysis - #1

Digi-Frame DF-1710

WxHxD : 17.83” x 14.5” x 2.9”

- Features
  - Wall mountable
  - Loads pictures via CD-ROM or internet via Ethernet
  - Displays JPEG/MPEG-1 and MP3’s
  - Remote control

Digi-Frame Pros and Cons

- Hidden functionality behind slim frame
- Variable mounting (vertical or horizontal)
- Large, clear display size (13”x10”)

- Not portable due to weight (19lbs.)
- CD-R0M drive affects mounting

Unique Aspects of the Digital Picture Box Design

- Separates image processing from display allowing great flexibility on choice of display screen and size (Any VGA controlled display screen)
- Small size makes design highly portable and unobtrusive

Commercial Product Analysis - #2

- Features
  - Plays JPEG/MPEG/MP3 file formats
  - Supports various memory cards and has USB driver
  - compatible with Windows and Mac OS
  - Interfaces with NTSC/ Pal TV's or TFT monitors
  - IrDA remote control

Vosonic Multi-media Viewer – 80

WxHxD : 98 x 89 x 15 mm

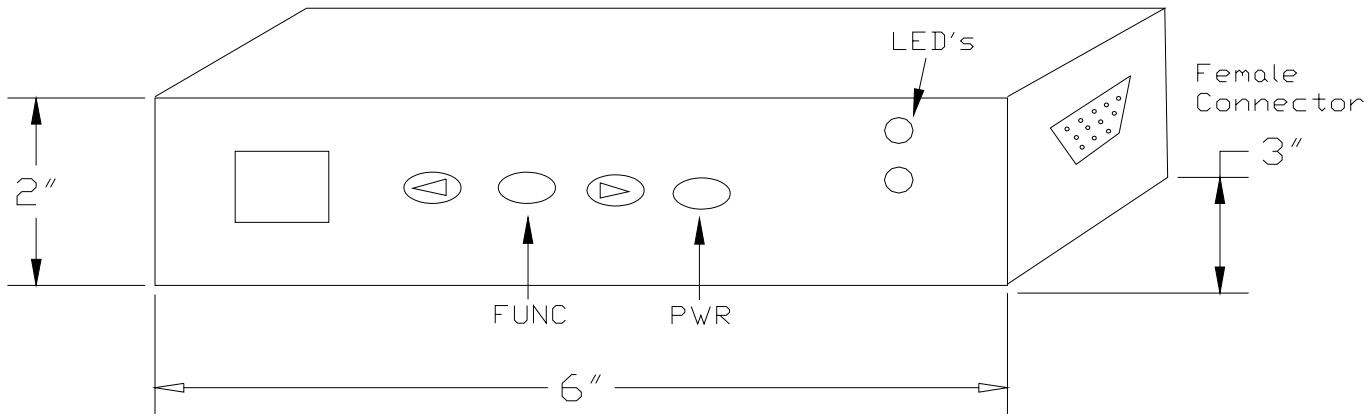
Weight : 81g

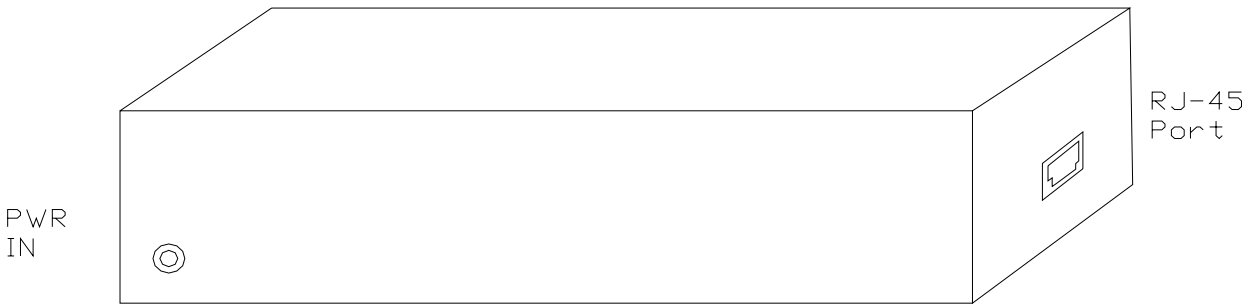
Product features we plan to copy/adapt to our design

- Compact light-weight design
- User-friendly button arrangement and labeling
- Arrangement of inputs and outputs allow for easy connection
- Wide front panel for easy IR signal reception

Initial Packaging Concept

Digital Picture Box (Top/Front view)





Digital Picture Box – Rear view

Weight and Cost Estimates

Part	Weight (oz / lbs)	Unit Cost ($)	Quantity	Total Cost ($)
Epson Graphics Controller	0.2 oz	14.40	2	28.80
EDO DRAM	0.2 oz	Sampled	1	0.00
Rabbit 3000 Core Module	1.0 oz	14.50	2	79.00
Pushbuttons	0.4 oz	0.25	4	1.00
15 pin HD Female connector	2.0 oz	1.00	1	1.00
LED's	-	0.50	2	1.00
Plastic Casing	1.0 oz	10.00	1	10.00
Total Weight	**4.8 oz**		**Total Cost**	**$ 120.80**

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Circuit Design and Schematic: Considerations

- Power supply considerations
  - Rabbit 3000 operates at 3.3 VDC
    - Can sink and source up to 6.8 mA current
    - Input pins are up to 5.5 VDC tolerant
  - IR module operates at 5 VDC
    - Requires 4 I/O pins @ < 2 mA operating current per pin

Circuit Design and Schematic: Considerations

- Power supply considerations
  - Epson Graphics Controller requires two separate power supplies
    - Analog 3.3 VDC
    - Digital 3.3 VDC
  - These must be separated so that digital switching noise does not inject itself, through a common ground, into the analog portion of the circuit. This would be very undesirable and a decrease in VGA display quality would be observed.

Circuit Design and Schematic: Considerations

- Power supply considerations
  - Epson Graphics Controller requires two separate power supplies
    - Analog 3.3 VDC
    - Digital 3.3 VDC
  - To prevent switching noise from entering the analog circuitry:
    - Two separate power supplies will be used.
    - A ferrite bead will be used to connect the analog to the digital ground at a single, regulated point. The bead will block high-frequency noise.
    - Several 0.1 uF decoupling capacitors will also be used.

Circuit Design and Schematic: Considerations

- Power supply considerations
  - To achieve required voltages, a standard unregulated 9 VDC “Wall Wart” will be used along with standard Low-Dropout Voltage Regulators to achieve:
    - 9 V to regulated VL 3.3V digital power
    - 9 V to regulated Analog VL 3.3V analog power
    - 9 V to regulated VL 5V digital power

Circuit Design and Schematic: Considerations

- IR Remote
  - Sharp receiver outputs the signal that drives transmitter on a remote control
  - Reynolds Electronics Sony IR Remote Decoder takes output from receiver and toggles a data pin corresponding to button presses on the remote. Can recognize buttons 0-9, channel +/-, and volume +/- on any Sony remote.
    - Operates at 5 VDC, but will be compatible with Rabbit I/O pins' 5.5 VDC voltage limit and 6.8 mA current limit

Circuit Design and Schematic: Considerations

- VGA Connector
  - Standard VGA connector fed by Epson RGB signals
    - Ferrite beads for low-pass filtering
    - BAV99 double-diode for surge protection
- LED/Pushbuttons
  - Only consideration is meeting 6.8 mA Rabbit source/sink limits

Circuit Design and Schematic: Considerations

- Epson Graphics Controller considerations
  - **21 bit address bus**
  - **16 bit data bus**
  - **Direct connection to 256k x 16 EDO RAM chip**
  - **Standard VGA connections**
    - RGB outputs – RED/GREEN/BLUE
    - Horizontal/Vertical Controls – HRTC/VRTC
  - **Important Control Signals**
    - Chip Select – CS#
    - Write Enable – WE1#/WE0#
    - Reset – RESET#
  - **IREF**
    - Requires 4.6 mA current reference supplied by NPN transistor

Circuit Design and Schematic: Considerations

- Other Design Considerations
  - 25.175 MHz Crystal Oscillator
  - 256k x 16 EDO DRAM
  - PLDs
  - Reset Controller

Future work

- Prototype major components
- Complete board layout
- Set up network server
- Software Development

? Questions ?

References for Major Components

[1] Rabbit 3000 Core Module
http://shay.ecn.purdue.edu/~477grp12/datasheets/rabbit3000_core_manual.pdf

[2]Epson Graphics Controller
http://shay.ecn.purdue.edu/~477grp12/datasheets/epson_manual.pdf

[3]Low-Dropout Voltage Regulators
3.3V
http://focus.ti.com/lit/ds/symlink/reg103-33.pdf
5V
http://focus.ti.com/lit/ds/symlink/reg103-5.pdf

[4]PLD
26V12
http://www.vantis.com/lit/docs/datasheets/pal_gal/26v12.pdf
16V8
http://www.vantis.com/lit/docs/datasheets/pal_gal/16v8.pdf

References for Major Components

IR

[5] Detector
http://shay.ecn.purdue.edu/~477grp12/datasheets/sharp_ir_detector_data.pdf

[6] Decoder
http://shay.ecn.purdue.edu/~477grp12/datasheets/rentron_ir_decoder.pdf

[7] DRAM
http://www.issi.com/pdf/41xx16256.pdf

[8] Crystal Oscillator

http://www.eea.epson.com/go/Prod_Admin/Categories/EEA/QD/Crystal_Oscillators/all_oscillators/go/Resources/TestC2/SG8002DB