VIDEO PHONE SYSTEM

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Block Diagram of Video Phone System (Top Level)

- Camera
- LCD
- Video Processor
- Flash Memory
- Video controller
- Clock and timing
- Main controller
- Audio and Video Data I/O port (Modem)
- Audio processor
- Flash memory
- Audio controller
- Speaker
- Microphone
- Audio Processor
- Main control sub-system
- Phone sub-system
- Video sub-system
Video Phone System (Feasibility Study)

**Video unit:**
- **Digital video processor:**
  DSP56651 (Motorola, $15 each);
  16-bit DSP, 70 MIPS
- **Video controller:**
  MC68HC16S2 (Motorola, $8 each).
- **Flash memory:**
  HY29F040 (Hyundai, 4MB module, $12 each).
- **Digital camera:**
  Loitech 961121 (Logitech, $30 each).
- **Liquid crystal display:**
  TX26D80VC1CAA (Hitachi, 10.4” TFT, $100 each).

**Telephone:**
- **Regular phone unit:**
  $8 each.
Video Phone System (Feasibility Study)

Audio unit:

- Digital audio processor:
  CS4912 (Cirrus Logic, $7 each);
  16-bit DSP, RAM for program and data.

- Audio controller:
  CS4281 (Cirrus Logic, $4 each).

- Flash memory:
  HY29F040 (Hyundai, 4MB module, $12 each).

Main controller and other components:

- Main controller:
  MC68HC16Z2 (Motorola, $10 each).

- Modem:
  WINCOMM56 (Jaton Corp. 56K, $15 each).
Video Phone System (Cost and Competition)

**COST:**

A) Audio processor and controller = $ 11
B) Video processor and controller = $ 23
C) Memory (4 MB audio, 4 MB video) = $ 24
D) Telephone = $ 8
E) Digital camera = $ 30
F) Modem = $ 15
G) LCD display = $ 100
H) Main microcontroller = $ 10
I) Design cost (assuming 100,000 sold) = $ 27

**Total:** = $ 250

**MSRP:**

**Price:** (40% gross profit margin) = $ 350

**Competition:**

Standalone: (record motion pictures) >$1,000
TV-based: (need TV) around $800
PC-based: (need PC, slow) around $100
Block Diagram of Video Phone System (Top Level)

- Camera
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- Video Processor
- Flash Memory
- Video controller
- Main controller
- Audio and Video Data I/O port (Modem)
- Audio processor
- Flash memory
- Audio controller
- Speaker
- Microphone
- Audio I/O
- Video I/O
- Video sub-system
- Main control sub-system
- Audio sub-system
- Phone sub-system
The Elements of a Speech Coding System

Diagram:
- Filter → A/D → Analysis → Quantizer → Coder
- Quantizer\(^{-1}\) → Decoder → Modem
- Storage → Channel → Modem
- Synthesis → D/A → Filter
Block Diagram of a LPC Coder

- Pre-emphasis
- Frame interval
- Pitch detector
- Coder
- Coded pitch and voicing
- LPC quantizer and coder
- Coded LPC coeff’s
- Multiplexor
- Digital channel
- Frame interval
- Widow length
- Correlation computation
- LPC analysis
- Coded gain
- LPC filter order
- Coded LPC coeff’s
- Coder
Block Diagram of LPC Decoder

- Demultiplexor
- Excitation model
- Pulse generator
- Noise generator
- Gain
- De-emphasis
- Linear predictor
- LPC coeff
Waveform of Input Signal

![Waveform of Input Signal](image_url)
Waveform of Output Signal

Input file size: 336KB; compressed file size 7KB; compression ratio is 48:1. Decompressed file size: 336KB.
Block Diagram of Video Phone System (Top Level)

- **Video sub-system**: Camera, Video Processor, Video controller, Flash Memory, Clock and timing, Main controller, Video I/O
- **Audio sub-system**: Audio processor, Flash memory, Audio controller, Speaker, Microphone, Audio I/O
- **Main control sub-system**: I/O port (Modem), Main controller

ECES488

VIDEO PHONE SYSTEM (AUDIO UNIT)

Yaqiang Wang & Hongwen Lu 4/27/00
State Diagram of Audio Unit (top level)

### State Diagram:

- **Standby (Idle)**
  - Transition to **Phonecomm** on `pickup`
  - Transition to **Respondtoline** on `ring=4`
  - Transition to **Respondtosystembutton** on button press

- **Phonecomm**
  - Transition to **Standby (Idle)** on `ring=4`

- **Respondtoline**
  - Transition to **Standby (Idle)** on `hangup`

- **Respondtosystembutton**
  - Transition to **Standby (Idle)** on `stop`
State Diagram of Audio Unit
(Respondtosystembutton subsystem)

- Standby (Idle)
  - Reset
  - Handleplay
  - Handlefwd
  - Handlerew
  - Handlehearann
  - Handlerecann
  - Handleplaymsg
  - Handledeletemsg
  - stopbutton
  - playbutton
  - fwdbutton
  - rewbutton
  - hearannbutton
  - recannbutton
  - playmsgbutton
  - deletemsgbutton

ECES488
State Diagram of Audio Unit (Respondtoline subsystem)

- Reset
- Standby (Idle)
- Initcomm
- Playannouncemement
- Recordmessage
- Checkcode
- Respondtoremotebutton
- Respondtoline
- ring=4
- dngup
- passwd=‘0’
- passwd=‘1’
- Remotecontrol
- remotebutton
- hangup
Symbol of Audio Unit Controller

CLK
Code_ok
DeleteMsgbutton
EndDeleteMsgbutton
EndFwdbutton
EndHearAnnbutton
EndPlaybutton
EndPlayMsgbutton
EndRecAnnbutton
EndRewbutton
Fwdbutton
Hangup
HearAnnbutton
Pickup
Playbutton
PlayMsgbutton
RESET
RecAnnbutton
Remotebutton
Rewbutton
Rspdline

Deletemsgbutton_ctrl
Fwdbutton_ctrl
Hearannbutton_ctrl
Phone_ctrl
Playann_ctrl
Playbutton_ctrl
Playmsgbutton_ctrl
Recannbutton_ctrl
Recmsg_ctrl
Respondtocmds_ctrl
Rewbutton_ctrl
Gate Level of Audio Unit Controller
Simulation Result for Audio Unit (Phonecomm and Respondtosystembutton subsystems)

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLK</td>
<td>0</td>
</tr>
<tr>
<td>RESET</td>
<td>1</td>
</tr>
<tr>
<td>Pickup</td>
<td>0</td>
</tr>
<tr>
<td>Hangup</td>
<td>0</td>
</tr>
<tr>
<td>Phone_ctrl</td>
<td>0</td>
</tr>
<tr>
<td>sreg</td>
<td>0000</td>
</tr>
<tr>
<td>Playbutton</td>
<td>0</td>
</tr>
<tr>
<td>Endplaybutton</td>
<td>0</td>
</tr>
<tr>
<td>Playbutton_ctrl</td>
<td>0</td>
</tr>
<tr>
<td>Fwdbutton</td>
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<tr>
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<td>Rewbutton</td>
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<tr>
<td>Endrewbutton</td>
<td>0</td>
</tr>
<tr>
<td>Rewbutton_ctrl</td>
<td>0</td>
</tr>
<tr>
<td>Hearannbutton</td>
<td>0</td>
</tr>
</tbody>
</table>

State | sreg
--- | ---
Idle  | 0000
Phone | 0001
Handle_play | 0111
Handle_fwd | 1000
Handle_rew | 1001
Simulation Result for Audio Unit (Respondtoline subsystem)

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>State</th>
</tr>
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<tbody>
<tr>
<td>CLK</td>
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<tr>
<td>sreg</td>
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<tr>
<td>RESET</td>
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<tr>
<td>Rspdline</td>
<td>0</td>
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</tr>
<tr>
<td>Hangup</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Remotebutton</td>
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<tr>
<td>Code_ok</td>
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<tr>
<td>Playann_ctrl</td>
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</tr>
<tr>
<td>Recmsg_ctrl</td>
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<td></td>
</tr>
<tr>
<td>Respondtocmds_ctrl</td>
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<td></td>
</tr>
<tr>
<td>Rewbutton</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Recannbutton</td>
<td>0</td>
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</tr>
<tr>
<td>Playmsgbutton</td>
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<td></td>
</tr>
<tr>
<td>Playbutton</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- **State**:
  - Initcomm: 0010
  - Playann: 0011
  - Recmsg: 0100
  - Check_code: 0101
  - Respondtocmds: 0110

- **Value**:
  - B 0000

- **Timeline**:
  - 0.0ns
  - 100.0ns 200.0ns 300.0ns 400.0ns 500.0ns 600.0ns 700.0ns 800.0ns 900.0ns 1.0ns
Conclusions

• **Cost/performance reduction approaches:**
  
  Hardware/software co-design;
  
  Off-the-shelf components (small quantity);
  
  In-house design and fabrication of chips (large quantity).

• **Competing with existing products:**
  
  Aiming at GSTN (analog phone line) market;
  
  Cheaper than existing standalone units;
  
  More convenient than TV-based or PC-based units.