

Think Different



Apple Computer, Inc.

# Apple iSnooze

EE459, Spring 2008

Senior Design Project

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# Objective

- Simple
  - No feature creep
- “It Just Works”™
  - No user manual
  - Intuitive
- Beautiful
  - Sleek and hip
  - Doesn’t look “cheap”

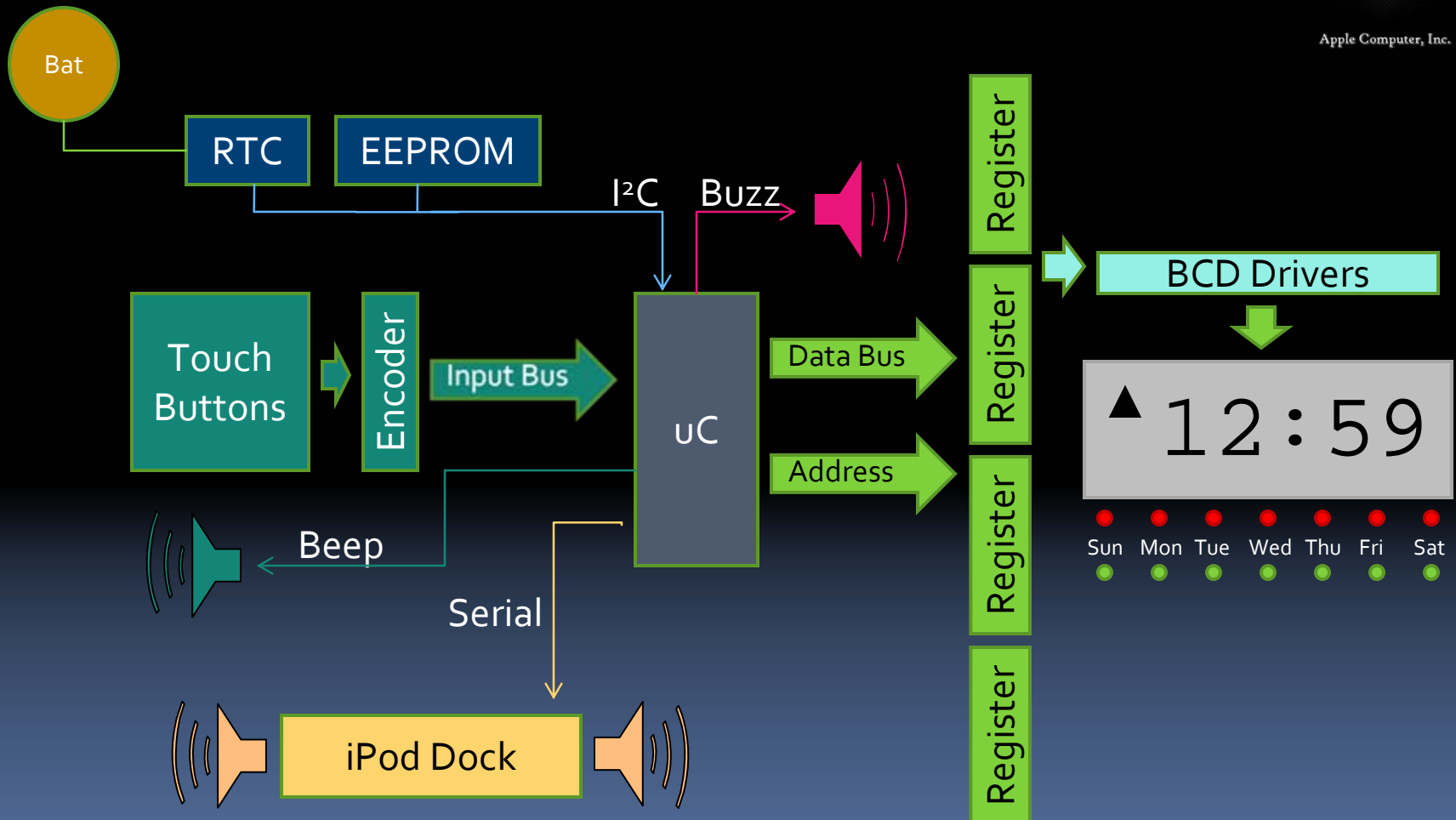


# Features

- “Think Different”™
  - Button less
  - Seamless iPod integration
  - Simple user interface
- Standard Features
  - Snooze
  - Alarm buzzer
  - 12/24 Hour
  - Battery backup



# Schematic

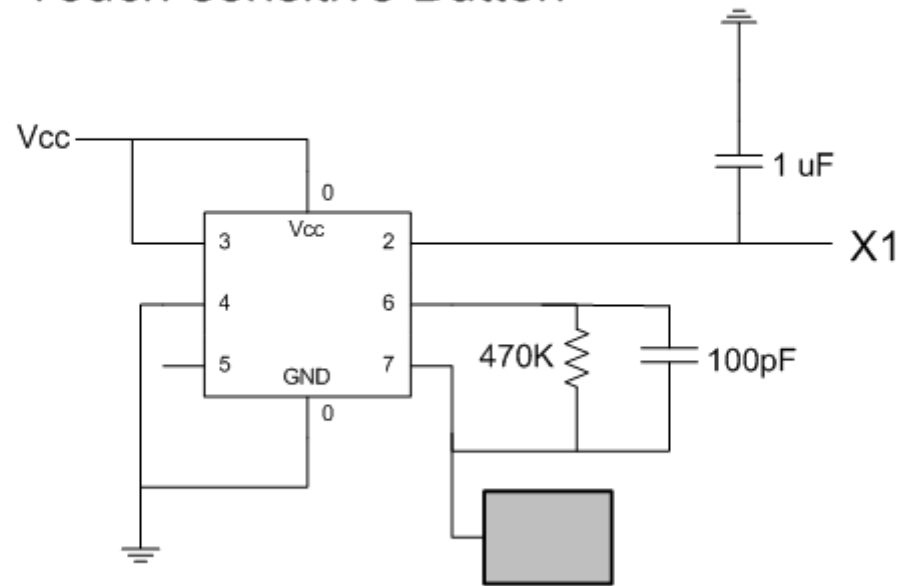




# Touch Sensitive Buttons

- QTouch Technology
  - Key design feature in iPod, iPhone
  - Allows us to design a sleek clock housing
- QT110 1-Channel
  - Detects change in capacitance as a finger approaches the electrode
- QT1103 10-Channel
  - QFN Package
  - Adjacent Key Suppression
- Problems
  - Soldering
  - Tactile Feedback
  - Routing of wires causes unwanted capacitance

# QT110 Touch-sensitive Button





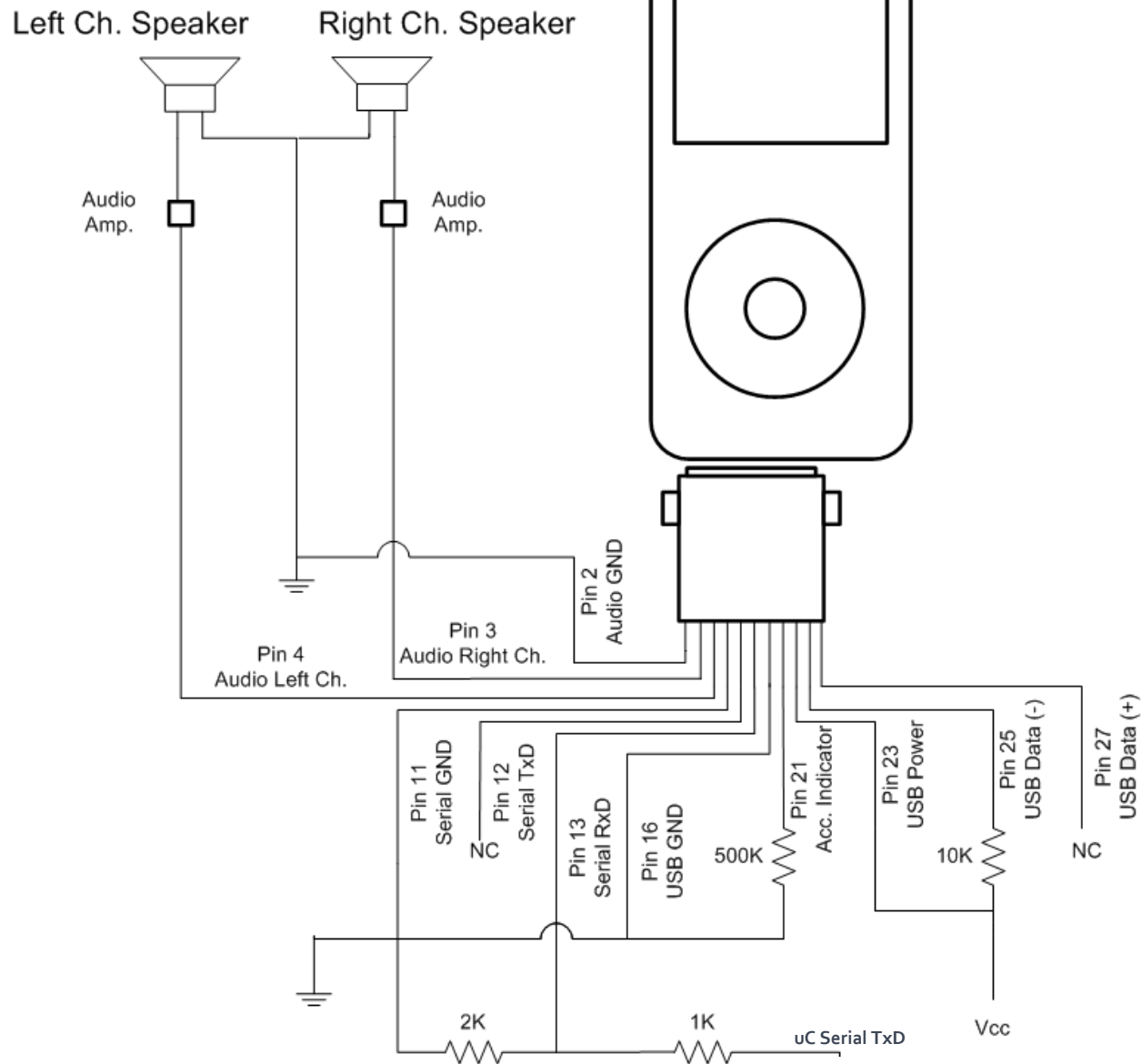
# iPod Integration

- Apple Accessory Protocol
  - Reverse Engineered
  - Poor documentation
  - Difficult to obtain parts
  - Difficult to obtain robustness
- Serial Communication
  - Accessory Indicator Resistor
  - Command Packets
    - Header
    - Length
    - Mode
    - Checksum =  $[0x100 - (\text{length} + \text{mode} + \text{command})]$
- Problems
  - Soldering

## Increase Volume Packet

|                |             |
|----------------|-------------|
| sci_write(FF); | // header   |
| sci_write(55); |             |
| sci_write(03); | // length   |
| sci_write(02); | // mode     |
| sci_write(00); | // command  |
| sci_write(02); |             |
| sci_write(F9); | // checksum |

# iPod





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# Demo



# Problems

- Backlight
  - Dead on arrival
- LCD Fades
  - BCD Driver chips unable to sink enough current
- iPod Integration
  - Not able to fully utilize protocol
- Audio Amplification
  - Feedback in op-amp circuit caused audio distortion



# Cost Analysis

| Part #         | Description               | Qty | Bulk Price | Total  |
|----------------|---------------------------|-----|------------|--------|
| MC908JL16CPE   | uC                        | 1   | \$2.19     | \$2.19 |
| VI-319-DP-FC-S | 7-Segment LCD             | 1   | \$6.80     | \$6.80 |
| KIT-LED-41     | LCD Backlight             | 1   | \$3.25     | \$3.25 |
| LEDs           |                           | 14  | \$0.27     | \$3.78 |
| 74LS374N       | Register                  | 4   | \$0.45     | \$1.80 |
| 74LS247        | BCD Converter             | 4   | \$0.96     | \$3.84 |
| 74LS08N        | Hex AND Gate              | 1   | \$0.32     | \$0.32 |
| 74LS138N       | 3-8 Decoder               | 1   | \$0.41     | \$0.41 |
| 74LS148N       | 8-3 Encoder               | 2   | \$0.80     | \$0.80 |
| DS1307         | RTC                       | 1   | \$1.69     | \$1.69 |
| 24LC256        | EEPROM 256k               | 1   | \$1.35     | \$1.35 |
| DS32KHZ        | Oscillator                | 1   | \$2.55     | \$2.55 |
| 10Mhz          | Oscillator                | 1   | \$1.27     | \$1.27 |
| QT1103         |                           | 1   | \$2.17     | \$2.17 |
| Resistors Pack | 330Ω, 1Ω, 2Ω, 10KΩ, 500KΩ | 6   | \$.31      | \$1.86 |



# Cost Analysis

| Part #            | Description                      | Qty | Bulk Price           | Total          |
|-------------------|----------------------------------|-----|----------------------|----------------|
| Capacitors        | 100pF, .1uF                      | 20  | \$0.10               | \$2.00         |
| 3.3v Battery      |                                  | 1   | \$0.85               | \$0.85         |
| Speakers          |                                  | 2   | \$1.59               | \$3.18         |
| Buzzer            |                                  | 1   | \$0.50               | \$0.50         |
| Piezo Speaker     |                                  | 1   | \$0.50               | \$0.50         |
| iPod Dock Adaptor |                                  | 1   | \$0.50               | \$0.50         |
| AC Adaptor        |                                  | 1   | \$4.35               | \$4.35         |
|                   |                                  |     | <b>Total</b>         | <b>\$45.96</b> |
|                   | <b>Apple Volume Discount 20%</b> |     |                      | <b>-\$9.19</b> |
|                   |                                  |     | <b>Cost Basis</b>    | <b>\$36.77</b> |
|                   |                                  |     |                      |                |
|                   |                                  |     | <b>Price Point</b>   | <b>\$49.99</b> |
|                   |                                  |     | <b>Profit</b>        | <b>\$13.22</b> |
|                   |                                  |     | <b>Profit Margin</b> | <b>26.4%</b>   |

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# Questions?