Musically Stimulated Environment

UCSB ECE 189 A/B Senior Capstone 2013

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What is Mu.S.E.?

- Mu.S.E. is your musical companion for the modern era.
- An embedded light sensor reads in ambient light levels.
- Combining this with an internal time clock, Mu.S.E. is able to automatically select the perfect playlist to stimulate your environment.
- By simply swiping your hand in front of the device, Mu.S.E. automatically begins playing.
- Mu.S.E. sets the tone for any occasion.
Picture this...
Picture this...
Picture this...
Picture this...
Picture this...
Picture this...
Picture this...
Picture this...
But how does it work?
How Does Motion Detection Work?
Complete motion detection solution

Surface-mount pyroelectric sensor and low-profile lens

Wide 5m x 6m, 60-degree detection pattern

Two different configurations:
- Hardware – Direct output
- Advanced Serial UART – “Talk” to CPU
CPU Communication

UART

100100101101

UART
How Does Light Sensing Work?
Incredibly small monolithic photodiode
- Measures 0.090 x 0.090 inches

On-chip transimpedance amplifier

Output voltage increases linearly with light intensity

Necessary to convert from analog to digital signal within the CPU

Light Sensor: TI OPT101
Putting It Together

UART

ZMOTION Detection Module

100100101101

ADC

010110110101

NXP

LPC2478
How Does Data Storage Work?
Non-Volatile Data Storage

- 2GB SD Card
  - Provides local storage for music library

- SDRAM: Micron MT48LC4M16A2P
  - 128 Mb of temporary storage
  - Provides a buffer between the SD Card and the music decoder
  - General purpose memory access for all peripherals
How Does Music Decoding Work?
Music Decoder: VLSI VS1011

- High-performance, low-power DSP processor core VS DSP4
- High-quality oversampling variable-sample-rate stereo DAC
- Communicates via SPI interface
- Decodes various audio formats including:
  - WAV, PCM, MP1, MP2, MP3 (up to 320 kbit/s)

(Yes, it’s that small)
Putting It Together
How Does User Interface Work?
LCD Display: Newhaven NHD-3.5-320240M

- Displays current song information and device status
- Supports up to 320xRGBx240 resolution
- Easily readable thanks to embedded LED backlight
  - 24-bit "truecolor" Parallel digital RGB interface (6.4MHz)
  - That’s 16,777,216 colors!
- Capacitive Touch Panel with SPI controller
Putting It All Together

And the CPU?

- UART
- ADC
- SD/MMC
- SPI
- LCD/SPI
- EMC
Central Processing Unit: NXP LPC2478

- Highly integrated microcontroller for a wide range of applications that require advanced communications and high quality graphic display
- 512 kB of on-chip high-speed flash memory
- LCD Controller, including support for TFT screens
- External Memory Controller provides support for synchronous dynamic memory devices
- SD/MMC memory card interface.
The Big Picture
Printed Circuit Board
Video Presentation
Words of Wisdom

- Start early, start early, start early...
- Read EVERYTHING
- Double check, triple check, quadruple check your connection
- Bring a sweater
  - Those nights get real cold
Our tireless (and worrisome) leader: Dr. John Johnson
A better man than most, our TA: Joseph Malcolm

Thanks to Jorge Gonzalez