ChessMate
Critical Design Review

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Project Description

ChessMate is an interactive, LED illuminated chess board that enhances a player's experience by providing various digital board augmentations. These include multicolor LEDs that automatically light up valid moves when a player picks up a piece and a touchscreen display that passively times each player as moves are made while displaying pertinent game information.

Application & Usage

- Designed to help visualize chess moves on the playing surface
  - "Middle-man" between player's thought-process and game-board
- Applicable to players of all skill levels
  - Assist new players in learning possible moves for each piece
  - Complement experienced user's knowledge with visual representation
  - Toggle LED illuminations to practice/play without visualized moves enabled
- Simple touch LCD interface to combine simplicity and accessibility
  - Easily start/restart a new game with 1-button press
  - Track pieces that have been taken
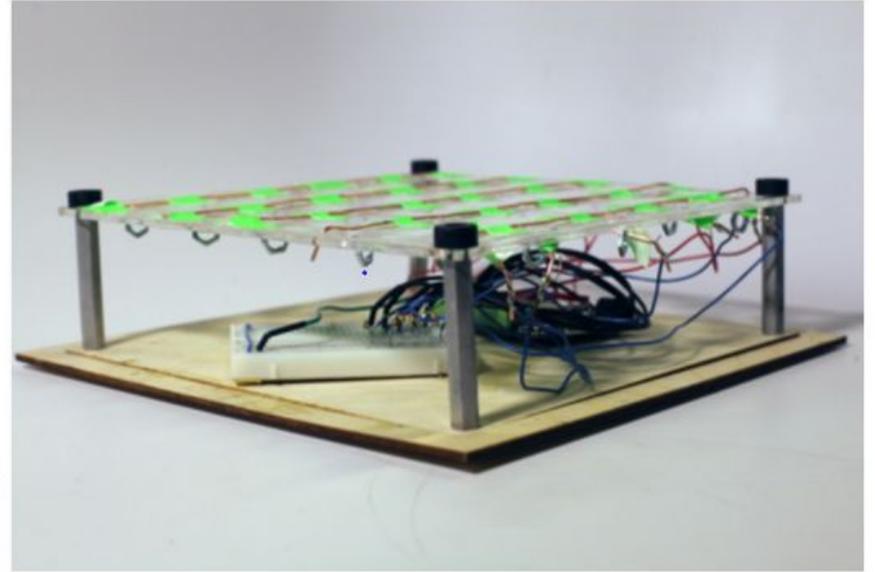 - Display last move made by each player
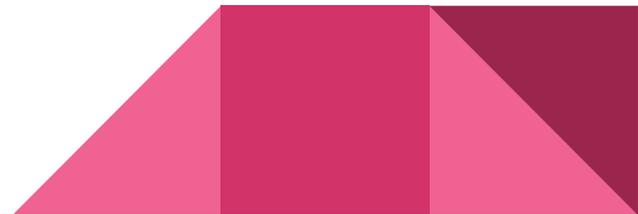
Design-Layout Abstraction
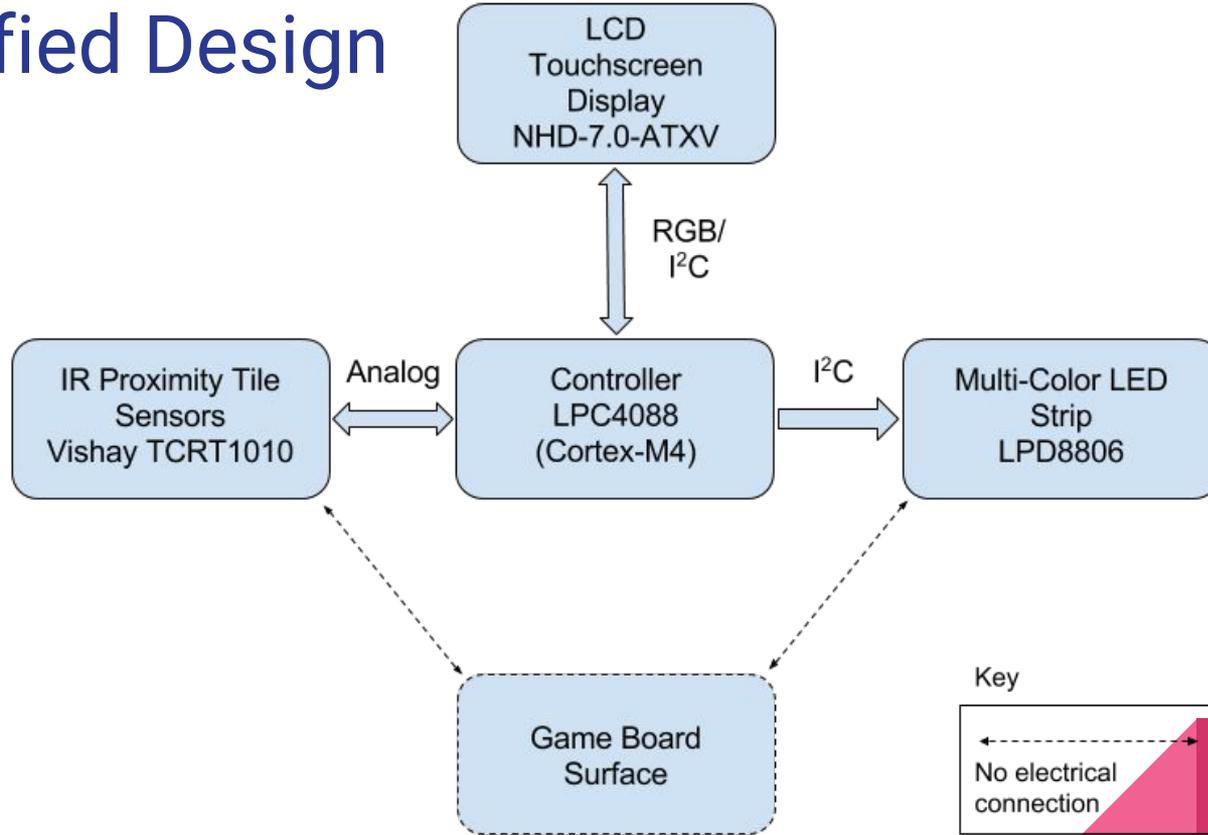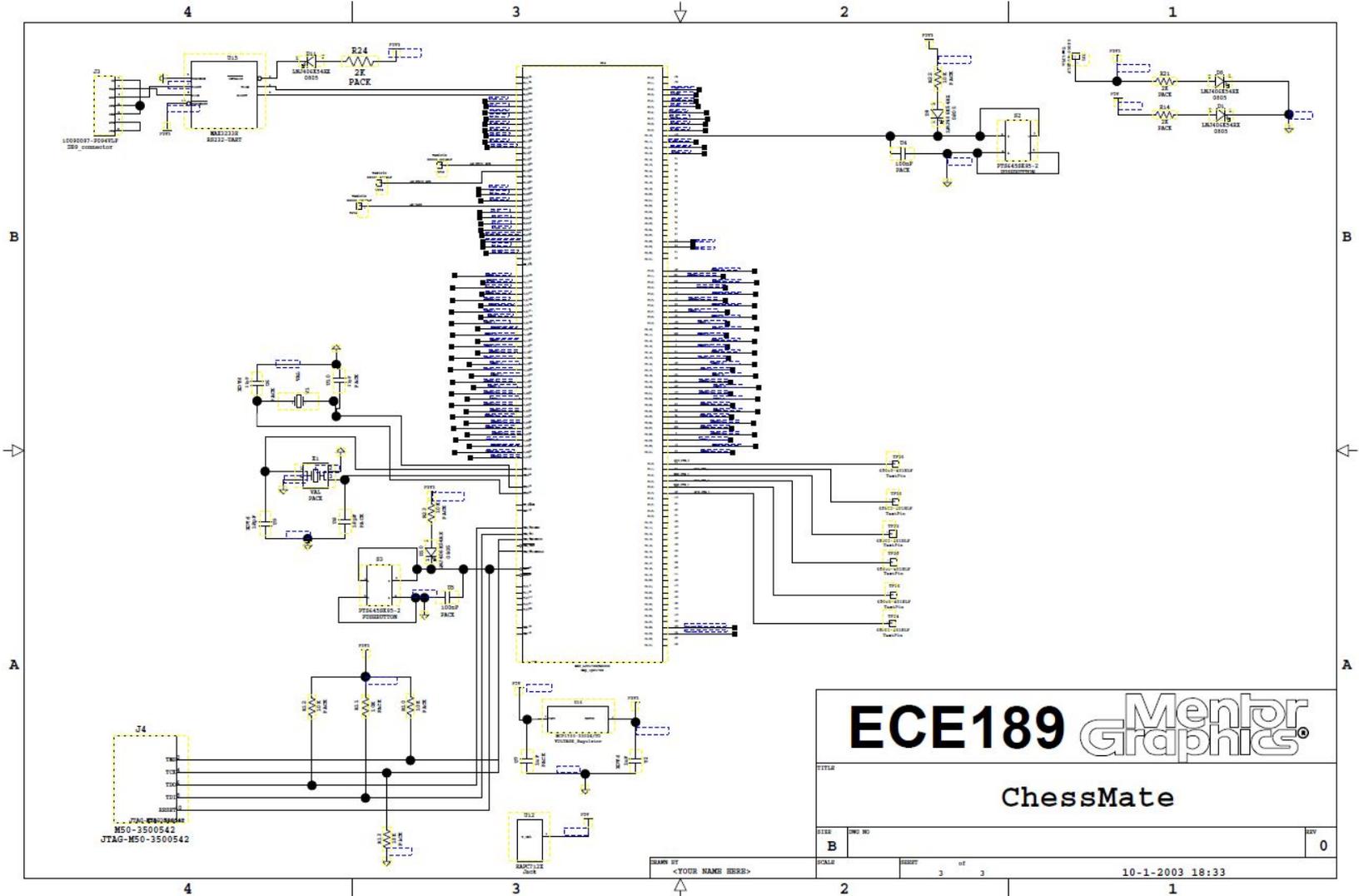

- Game Surface
- IR Proximity Sensors
- Digital LED Segment
- Vectorboard
- Assembled PCB

Simplified Design

LCD Touchscreen Display NHD-7.0-ATXV

RGB/ I^2C

IR Proximity Tile Sensors Vishay TCRT1010

Analog

Controller LPC4088 (Cortex-M4)

I^2C

Multi-Color LED Strip LPD8806

Game Board Surface

Key

No electrical connection

ECE189

Mentor Graphics®

TITLE

ChessMate

| SIZE	DWG NO		REV
B			0

IR Proximity Sensor - Vishay TCRT1010

- Proximity Infrared Sensor
  - Detect when a piece is on/off a specific square
  - Tweaking needed to find "sweet spot"
  - Sunlight could play a factor - prototype!
- Analog output - convert to "digital" for simplicity
  - Schmitt triggers perform the conversion
  - Binary 0/1 determines if space is occupied
- One sensor per square - 64 total
  - Common GND/voltage for each sensor
  - Unique sensor lead passed through schmitt trigger
  - Board reads sensor and updates piece location
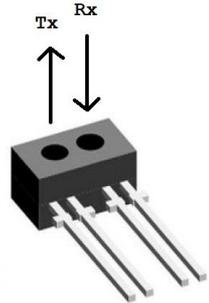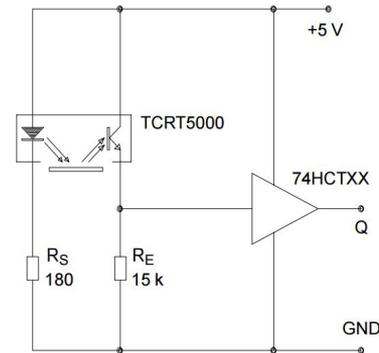
LED Strip - Adafruit Digital RGB LED Strip

- Digitally controlled LED's
  - Individually control each LED
  - 2 daisy-chained strips for the entire board
- LEDs illuminate a possible/valid move
  - Player-specific colors - BLUE/GRN
  - Special move (castle, check) color - YLW
  - Eliminated piece - RED
- Strips placed beneath row of tiles
  - One LED segment per square
  - Daisy chained connection - serially load bits
  - Common power/ground for both strips
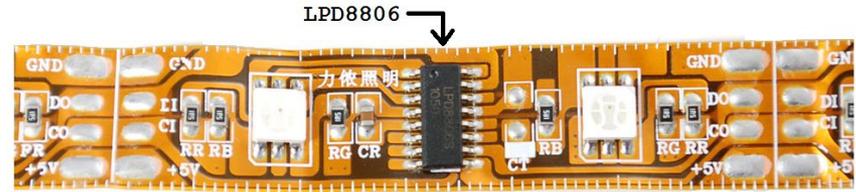
Vector Board

- Bridges the external and on-board PCB components
  - Sensor and LEDs communicate with PCB but are off-board
  - Only unique signals need to be sent to/from the PCB
- Simplified connections
  - Allows for common GND/Vcc for all sensors & LED daisy chains
  - Can be placed at optimal sensing and wiring distance
  - Reduces required number of wires coming from PCB
- Debugging is heavily external
  - Few components physically on the PCB itself
  - Isolate problems off of the board - no need to resolder components
  - Resistor arrays and Schmitt triggers connected where necessary

Critical Elements & Possible Issues

- Wiring Mess!
  - Neat wiring and organized sensor/header placement on the board for easier management
  - 64 sensors * multiple pins + multiple daisy chained LED strips
- Smooth sensor-to-tile interfacing for each tile & piece
  - An accurate and stable reading is needed for good results and piece location
  - What if multiple pieces are picked up simultaneously?
  - What if someone drops a piece? Multiple sensors go high
- Monitor and maintain piece locations in memory
  - Based on initial conditions - starting position is always known!
  - Special moves need to be considered - checking, castling, etc
- Smooth GUI Design and LCD Interface
  - Bluetooth App in case LCD fails