Super User Do Chess

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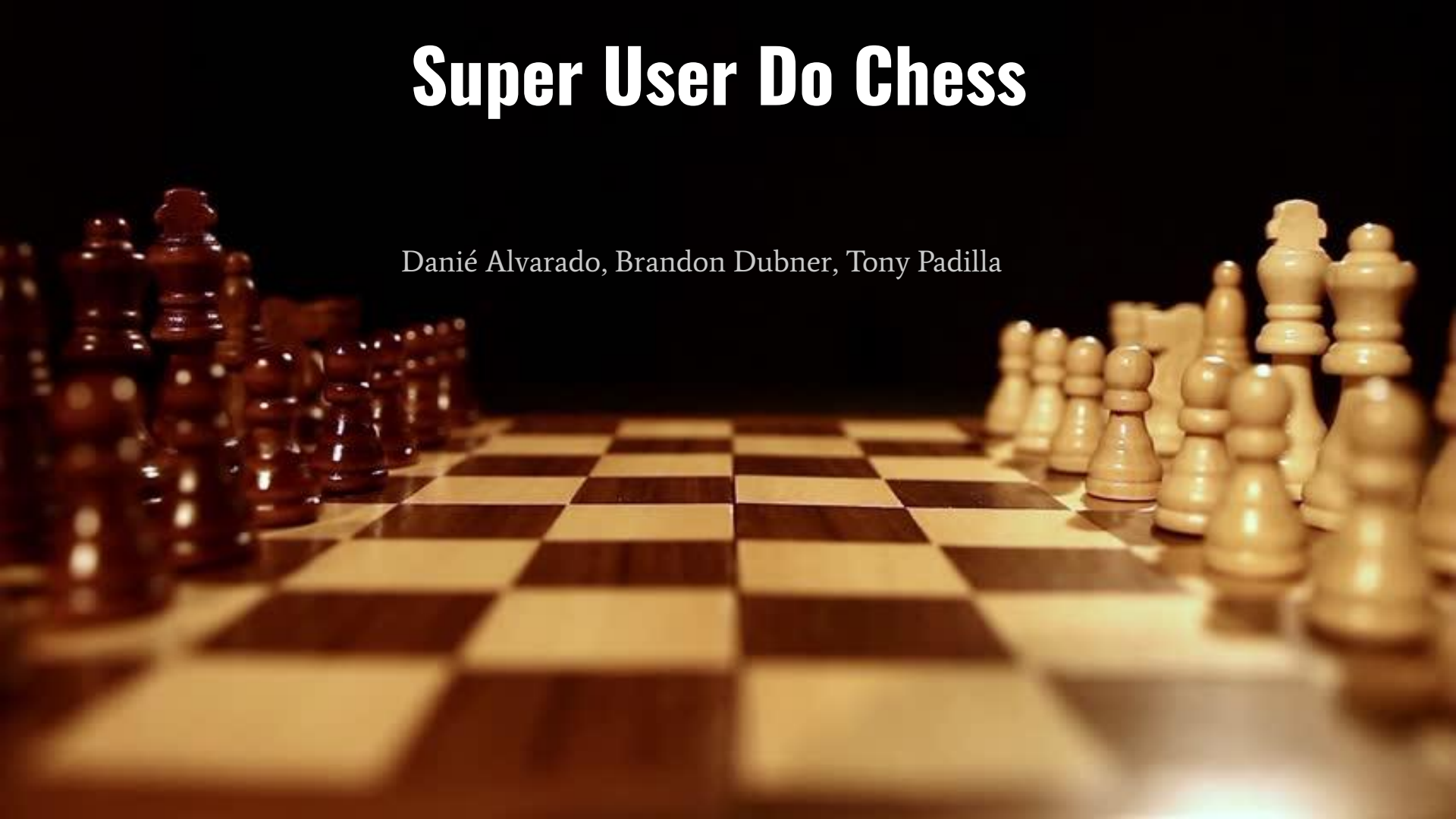


Use Case: Online Chess

- Play Chess online - with a physical board
- Have the feeling of playing with a friend without having to stare at a screen

Project Breakdown

Piece Detection

Detect pieces on the board

Piece Movement

Move opponent's pieces

Web Communication

Interface to a web app to play your opponent

Hardware

Software

Requirements - Piece Detection

- Distinguish each piece type and color
  - Should be able to distinguish a white pawn from a black pawn but not necessarily one white pawn from another white pawn
- Receive piece information for all 64 squares within 100ms

Key Technical Challenges

- Handling edge cases: What happens if info is missing
- Detect pieces without inhibiting our movement system
- Circuit to communicate the piece information to microcontroller

Requirements - Piece Movement

- Automatically move a piece to any other square on the board without collision
  - ~500x500mm board size
- Any one movement should take no longer than 5 seconds

Key Technical Challenges

- Generating enough power to drive the motors at the desired speed
- Interfacing with stepper motor driver
- Reducing sound while maintaining performance
- Figuring out the motions for each possible movement

Requirements - Web Communication / Application

- Ability to connect a board to PC through UART
- Ability for Web App to get board state from board
- Ability for Web App to send a move to be reproduced on the board

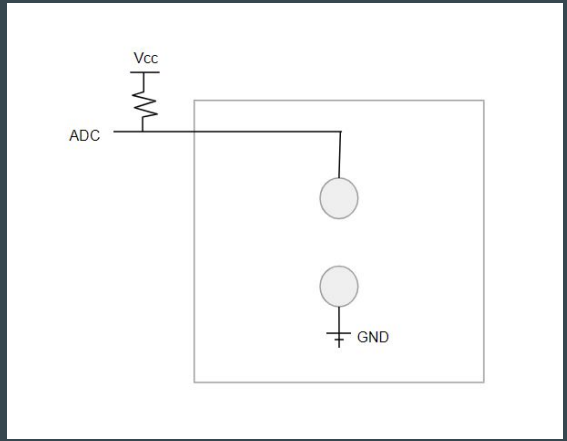
Key Technical Challenges

- Dealing with latencies
- What to do in error cases, if pieces get knocked over, illegal move, etc.

Solution Approach - Piece Detection

- Voltage divider connected to an analog-to-digital converter on our microcontroller

- Each piece has metal plates at the bottom with a specific resistance



Solution Approach - Piece Movement

- Electromagnet to grab and release pieces

- Double linear motion slide actuators to move the electromagnet under the board

Solution Approach - Web

- Webapp
  - Interface for players to play the game
  - Communicates with the board
- Serialport and ws (websocket) javascript library used to communicate piece positions between board and web app using USB connection

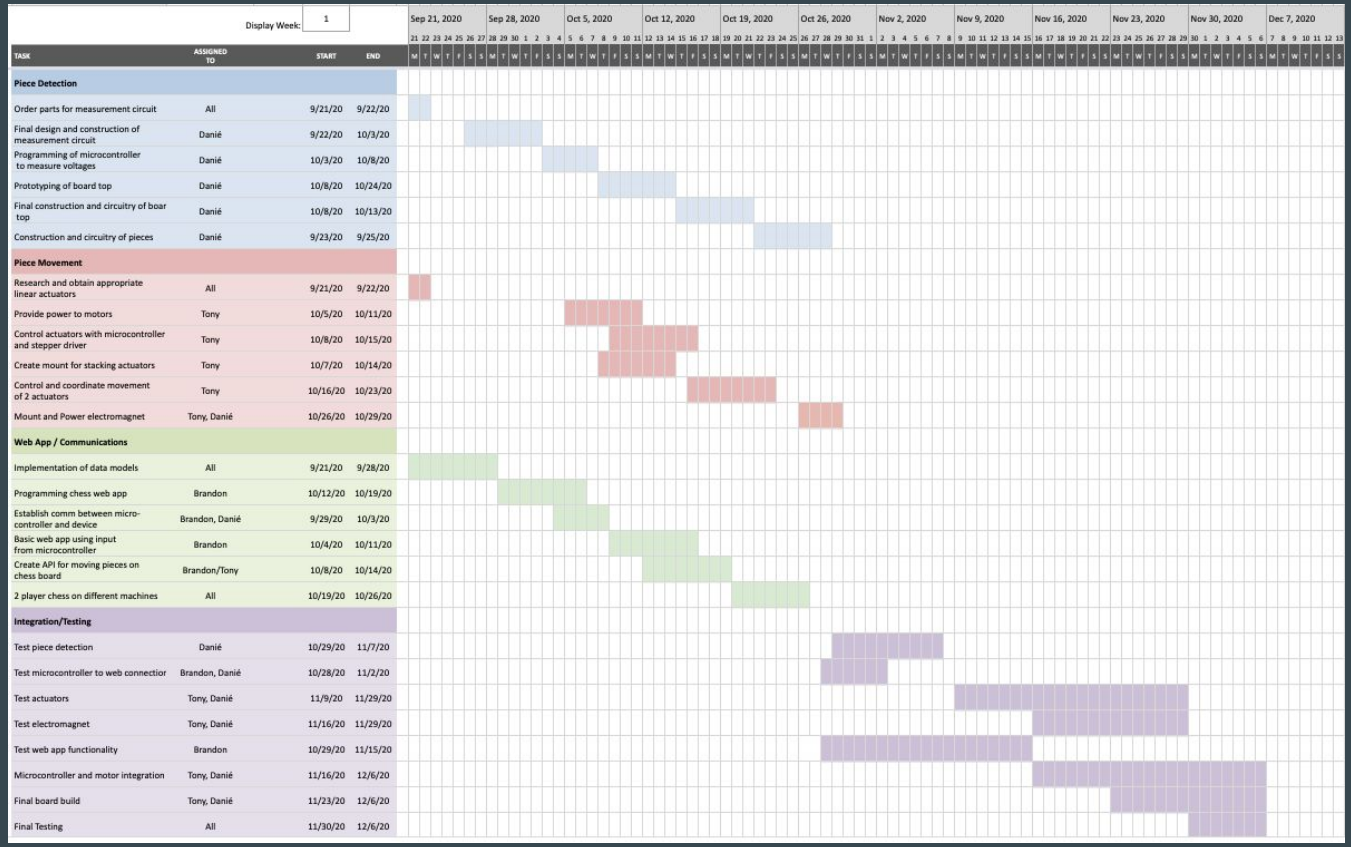
Testing, Metrics, Verification

- Test piece detection with varying frequencies to determine best one that:
  - Meets requirement to measure **all 64 squares** in under **100ms**
  - Low enough frequency to avoid erroneous readings.
- Test the UART to Web connection
  - Ensure data is transferred correctly from board to computer to browser
- Test linear actuators to
  - Ensure they can be programmed to correctly stay in the designated path for **no piece collisions**
  - Ensure they can move a piece from one corner of the board to the opposite in **under 5 seconds**
- Test electromagnet to
  - Properly adjust to **smoothly** moving the pieces from one square to another

Tasks

1. Piece Detection
2. Piece Movement
3. Web Communication / Application
4. Integration and Testing

Gantt Chart



Display Week: 1

TASK	ASSIGNED TO	START	END
Piece Detection			
Order parts for measurement circuit	All	9/21/20	9/22/20
Final design and construction of measurement circuit	Danié	9/22/20	10/3/20
Programming of microcontroller to measure voltages	Danié	10/3/20	10/8/20
Prototyping of board top	Danié	10/8/20	10/24/20
Final construction and circuitry of boar top	Danié	10/8/20	10/13/20
Construction and circuitry of pieces	Danié	9/23/20	9/25/20
Piece Movement			
Research and obtain appropriate linear actuators	All	9/21/20	9/22/20
Provide power to motors	Tony	10/5/20	10/11/20
Control actuators with microcontroller and stepper driver	Tony	10/8/20	10/15/20
Create mount for stacking actuators	Tony	10/7/20	10/14/20
Control and coordinate movement of 2 actuators	Tony	10/16/20	10/23/20
Mount and Power electromagnet	Tony, Danié	10/26/20	10/29/20
Web App / Communications			
Implementation of data models	All	9/21/20	9/28/20
Programming chess web app	Brandon	10/12/20	10/19/20
Establish comm between micro-controller and device	Brandon, Danié	9/29/20	10/3/20
Basic web app using input from microcontroller	Brandon	10/4/20	10/11/20
Create API for moving pieces on chess board	Brandon/Tony	10/8/20	10/14/20
2 player chess on different machines	All	10/19/20	10/26/20
Integration/Testing			
Test piece detection	Danié	10/29/20	11/7/20
Test microcontroller to web connectior	Brandon, Danié	10/28/20	11/2/20
Test actuators	Tony, Danié	11/9/20	11/29/20
Test electromagnet	Tony, Danié	11/16/20	11/29/20
Test web app functionality	Brandon	10/29/20	11/15/20
Microcontroller and motor integration	Tony, Danié	11/16/20	12/6/20
Final board build	Tony, Danié	11/23/20	12/6/20
Final Testing	All	11/30/20	12/6/20