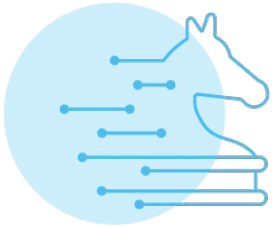


IntelliChess

Gambit Systems Inc.

The Gambit Systems Team

Marco
CEO

Project Planning
Computer Engineering
Student

Husam
CFO

Asset Tracking
Systems Engineering
Student

Malcolm
COO

Administrative
Computer Engineering
Student

Taha
CCO

Communications
Systems Engineering
Student

Eric
CTO

Tech Expertise
Computer Engineering
Student

The Inspiration

Problems we see:

- Online chess lacks the feeling of a physical chess board, it's just not quite the same
- With the current COVID situation, it's nearly impossible to find someone to play chess against

Our solution:

- Integrate some of the key benefits of online chess into a real physical chess board.
- Lower the barrier of entry for new chess players by learning interactively

[1] https://www.youtube.com/watch?v=IwjZ1J2b8UY

Our Solution (1:08)

Presentation Outline

- System Overview
- Technical Breakdown
- Market Analysis
- Alternative Designs
- GUI and Board (PoC and Eng. Prototype)
- ENSC 440 Schedule & Approach
- Self Reflection

System Overview

Companion App (iOS and Android)

Companion application with all the functionality of virtual chess

BLE Communication Channel

Very efficient and does not require internet connection or a tedious pairing process

Physical Board

Premium quality chess board that can move its own pieces

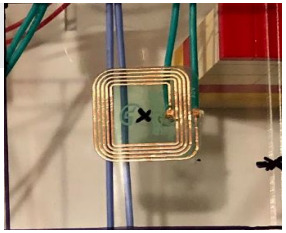
IntelliChess System

Technical Breakdown

Piece Detection - RFID

- RFID antennas multiplexed into an NFC reader
- Able to identify when a chess piece has been placed or removed
- Reads in multiple times a second and used to show virtual board on mobile application
- Tags have been chosen to work in magnetic and metal based environment

RFID Antenna



Piece Movement -Linear actuator based mechanical gantry

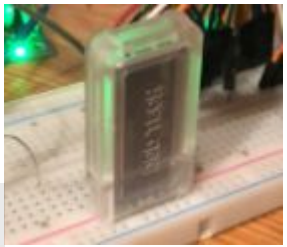
- Able to engage chess pieces for movement with the electromagnet
- Able to move pieces in all dimensions*
- Does not require any physical user input to function*

Mechanical Gantry

Companion App - React Native

- The “brains” of the product -- hosts the chess engine to analyze games*
- Used for setting up games and tracking game progress and results*
- Shows the pieces digitally in real time
- Assist users with match analysis and feedback*
- Uses BLE technology to communicate with microcontroller

BLE Module



* not yet implemented for PoC

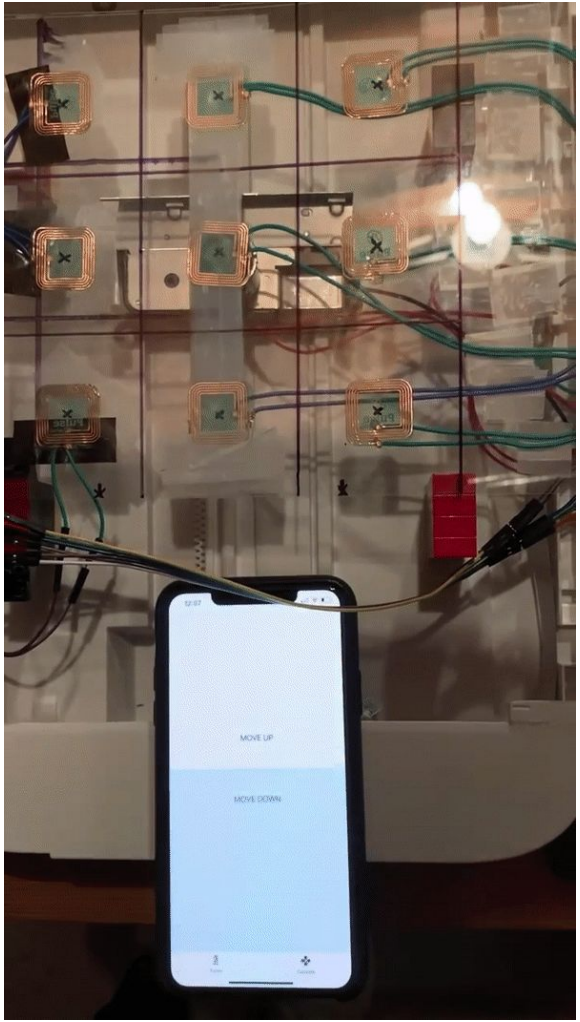
The Movement System

Linear actuator based movement system:

- The current system is extracted from an scanner, repurposing its track and DC motor to carry our electromagnet
- Currently only supports movement in one dimension
- The second dimension will use a similar mechanism, and as of now, the parts are ready for assembly

Why we chose it:

- A lot more stable and predictable movements when compared with our original solenoid-based design
- Controlled using the microcontroller + BLE module, and commands are sent by the companion app



PoC Tests

Test Description	Pass/Fail
3x3 board initially empty, chess GUI shows empty board	
Place chess pieces on the board and indicate that they have been detected through the chess GUI	
Replace one of the pieces with another, and show that chess GUI has updated	
Remove all pieces except one, showcase piece movement in all directions (forwards, backwards and diagonal)	
Repopulate board and showcase a piece moving in between other pieces to the desired square	

Testing (02:05)

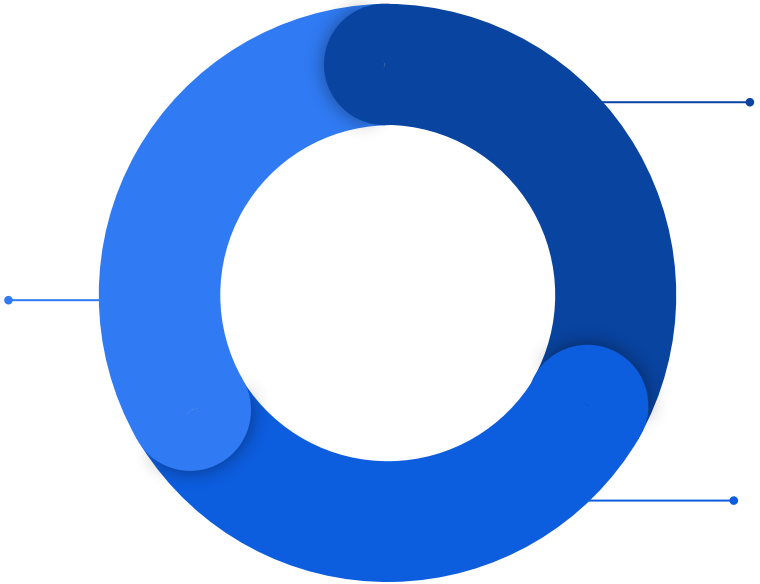
Testing Results

Test Description	Pass/Fail
3x3 board initially empty, chess GUI shows empty board	Pass
Place chess pieces on the board and indicate that they have been detected through the chess GUI	Pass
Replace one of the pieces with another, and show that chess GUI has updated	Pass
Remove all pieces except one, showcase piece movement in all directions (forwards, backwards and diagonal)	Fail
Repopulate board and showcase a piece moving in between other pieces to the desired square	Pass

Market Analysis - Overview

Online chess viewership reached all time high

- Big streamers average 70k viewers
- Chess tournaments started streaming live events



Market expected to double in 2022 from 2016 [2]

- $41M in NA
- Increase in chess book sales

Media and COVID-19 has had positive impact

- Chess rise started before
- COVID simply accelerated

Survey Results

178 responses:

- Strong support for a self-moving chess board
- 90.4% respondents have played virtual chess
- 75.2% have played physical chess

Major takeaways for our requirement specifications:

- Maintain the raw immersiveness of physical chess
- Provide ability to conduct match analysis after the game has ended
- Allow users to access a real-time coach to review their moves
- Allow users to select level of difficulty for opponent

Lack of a physical board was one of the most popular complaints for virtual players!

Market Analysis – Customer Focus

Target: Chess players

- Beginners wanting to learn the game
- Casual players who want to enjoy the tactile aspect of the game
- Professionals wanting to improve their decision making

Knowledge Required to operate product:

- General introductory rules of chess
- Short user manual for physical board operation

Key considerations:

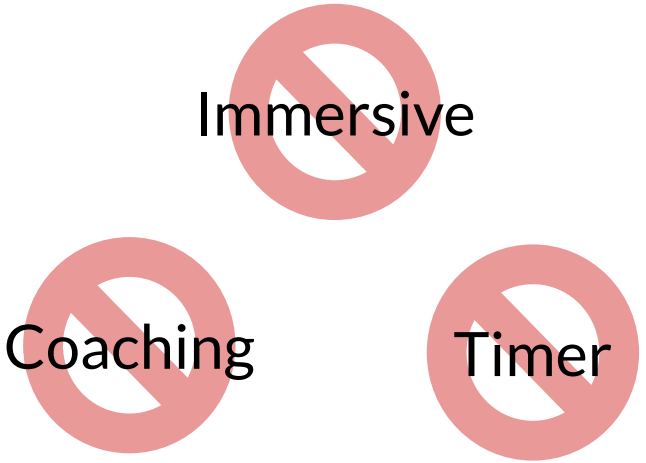
- Provide seamless connectivity experience
- Product should be robust with no exposed electronics
- User should be able to use it without internet access

Competitor Analysis

- **Main competitor: SquareOff**

Price: $562 (CAD) [3]

- **What are they missing?**



Cost Analysis and Financing

PoC Prototype: $207.61

Piece Detection system:$61.09
- RFID tag+antennas: $10.11
- RFID NFC Module: $34.58
- Multiplexer: $16.40

Piece Movement system: $70
- Electromagnet: $10
- Linear actuator: $60

Other: $76.52
- BLE module: $14.99
- Arduino Mega: 18.99
- Plexiglass: $10
- Chess pieces: $16.79
- UHMW tape: $15.75

Eng. Prototype: $441.02

Piece Detection system: $234.5
- RFID tag+antennas: $150
- RFID NFC Module: $34.58
- Multiplexer: $50

Piece Movement system: $130
- Electromagnet: $10
- XY gantry: $120

Other: $76.52
- BLE module: $14.99
- Arduino Mega: 18.99
- Plywoods: $10
- Chess pieces: $16.79
- UHMW tape: $15.75

Financing:

→ **ESS Endowment Fund**

→ **Wighton Engineering Development Fund**

→ **IEEE Student Branch Fund**

Concepts Proven

1. **Piece Movement**

Piece movement through electromagnetic engagement

2. **Piece Detection**

Piece detection through a multiplexed RFID system

3. **Companion App**

Real-time updates on mobile application using BLE

Technical Design Alternatives

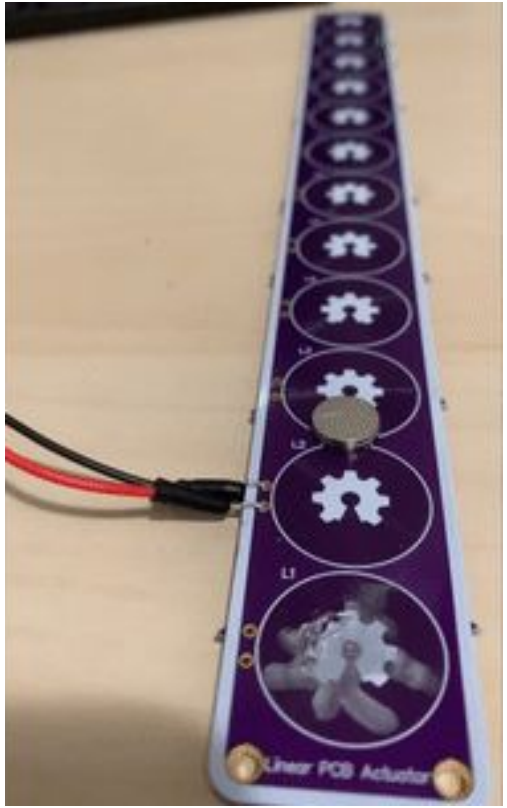
PCB based electromagnetic movement system:

Pros:

1. Noiseless
2. Compact and lightweight
3. Uses less power overall

Cons:

1. Inherently amplifies friction
2. Not strong enough to move a strong or loaded magnet
3. Movement is fixed based on solenoid positioning



Technical Design Alternatives

Hall Sensors

Pros:

1. Cheaper than RFID readers
2. Easier to implement with microcontroller
3. Less prone to breaking

Cons:

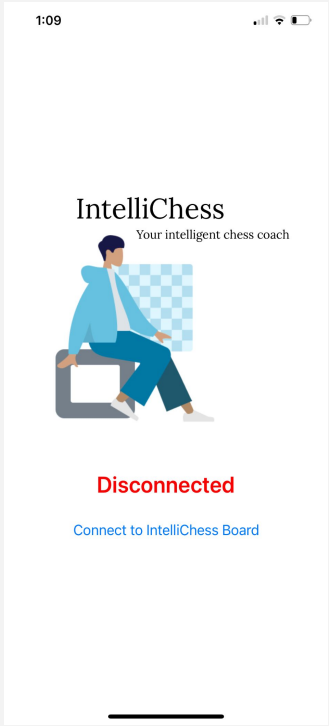
1. Interferences with electromagnetism and metal
2. Cannot uniquely identify pieces, must be through a recognition algorithm
3. Pieces must be tracked through software

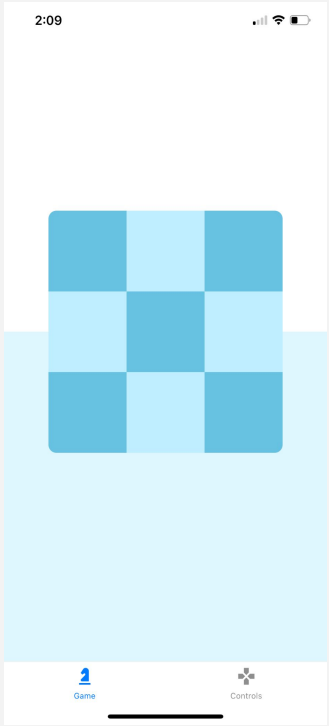
[4]

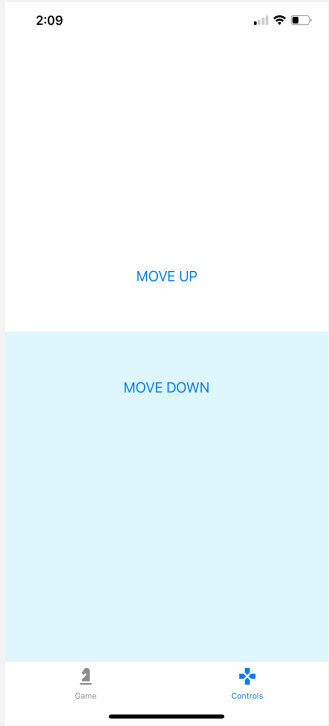
Failed Attempts (1:01)

Appearance - PoC GUI

iOS version shown, but same GUI is available on Android

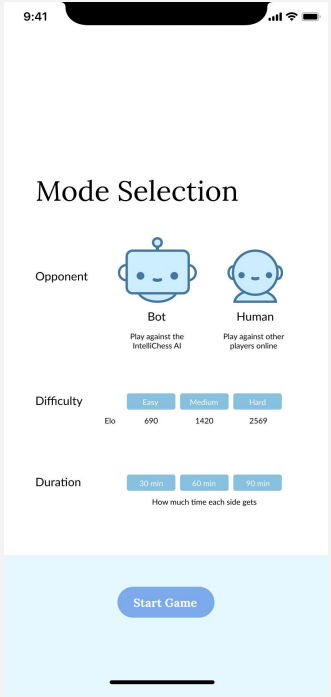


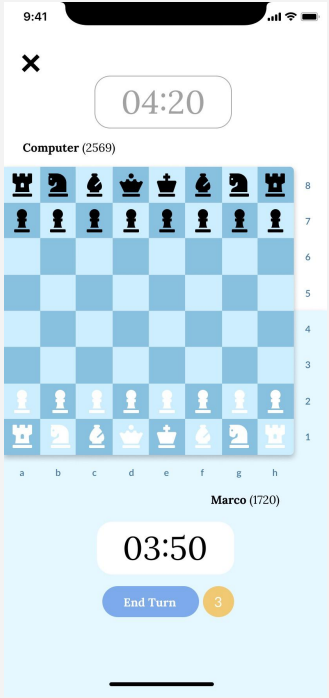


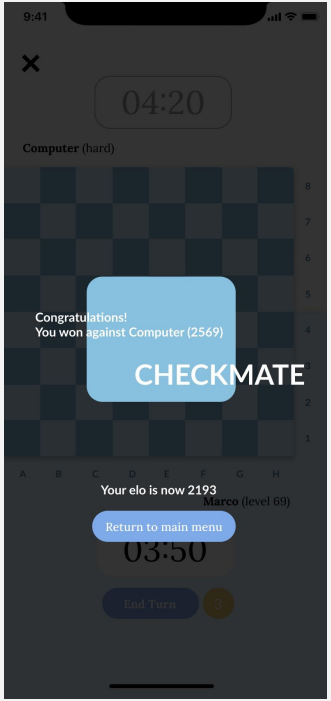


Appearance - Engineering Prototype GUI

These additional screens will be implemented in the Engineering Prototype GUI



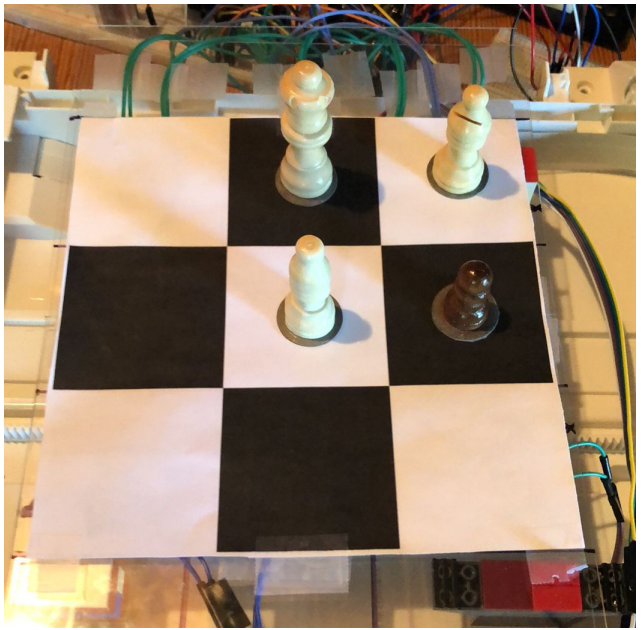




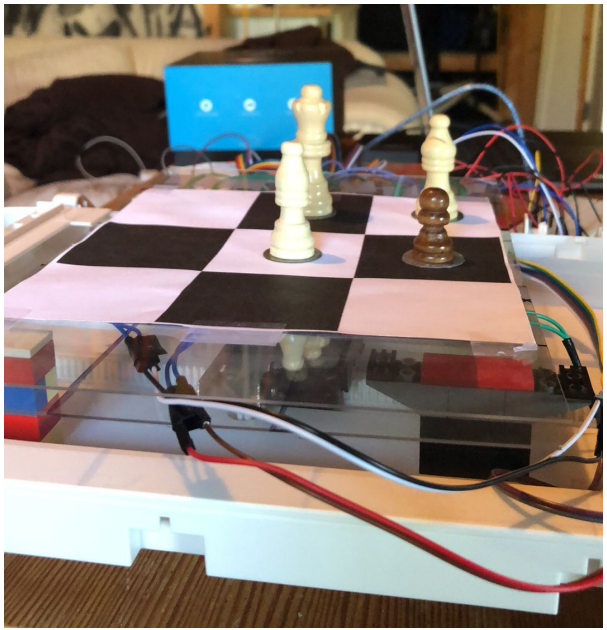
Appearance - PoC Board

These are photographs of our physical board created for the PoC demonstration

This board includes the most essential features, and does not represent the final product



Top View of PoC Board



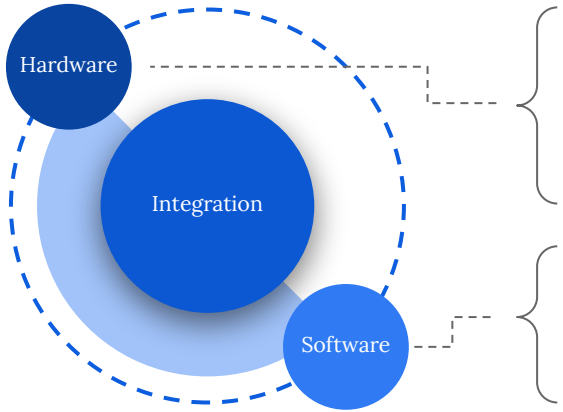
Side View of PoC Board

Appearance - Prototype Board

These are photographs of our physical board that will be created for the Engineering Prototype

This is simply an appearance model, and does not include any functional parts

The Next Steps



TASKS	MAY	JUNE	JULY	AUGUST
Y-MOVEMENT				
IMPLEMENT FULL 64 PIECE RFID SYSTEM				
ASSEMBLE FULL PHYSICAL BOARD				
INTEGRATE CHESS ENGINE				
AUTONOMOUS MOVE GENERATION				
PREPARE BETA PRESENTATION				

Member Roles

Marco

Project Planning

Mobile Application R&D

BLE Setup

Husam

Movement System R&D

BLE Setup

Prototype Assembly

Malcolm

Communication with Instructional Team

Movement System

Shop Specialist

Taha

Movement System R&D

Documentation Writing

Eric

RFID Piece Detection System R&D

Prototype Assembly

Self Reflection

What we learned as a team:

- ★ How to work as a team, and play to each of our strengths and experiences
- ★ How to schedule and plan our project ahead of time, taking care of deadlines and shifting priorities as we moved along the semester
- ★ How to use technology to streamline our workflow

What could have been done better:

- ❖ Fell down the rabbit hole of experimenting and trying to make the solenoid idea work despite many setbacks and warnings
- ❖ Didn’t reach out for help when needed, despite having great resources available to us, such as the instructional team
- ❖ Could’ve spent more effort and time on the documents

Feedback

Company Changes:

- Renaming the company due to issues of our name “Antebellum” being a source of controversy in the United States, one of our target markets.

Technical Changes:

- Instructional team shared concerns regarding capabilities of solenoid based movement system. After weak testing results, the recommended mechanical gantry was adopted instead.

Questions

& we answer them

References

[1] https://www.youtube.com/watch?v=IwjZ1J2b8UY

[2]https://www.statista.com/statistics/809953/global-chess-market-size/#statisticContainer

[3] https://squareoffnow.com

[4] https://ie.rs-online.com/web/generalDisplay.html?id=ideas-and-advice/hall-effect-sensors-guide