

MaGomoku

Project Proposal

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Introduction

A **networked, automated Gomoku set** to level-up the gaming experience where players can play with actual Gomoku pieces on a physical game board against online players and AI opponent.

Utilizing **maglev** technology, the opponent's Gomoku pieces will automatically *levitate, move, and land* on the game board during each turn.

***Gomoku**, also called Five in a Row, is an abstract strategy board game. It is traditionally played with Go pieces (black and white stones) on a 15×15 Go Board. Currently, there are only either a physical Gomoku set that can only be played offline, or a purely software game that can be played online.*



Credit: https://store.steampowered.com/app/1555400/_/

Use Case

- Gomoku Lovers who want to level-up their experience
- Want to enjoy the physical game with online friends
- Elderly Users who are not familiar with online Gomoku games
- Tech enthusiast who want to try out magnetic levitation devices
- Interesting game that can kill time and bored



Use Case Requirements (Detection & Board Integrity)

- Able to distinguish between black and white pieces (**100%**)
- Able to determine the exact location of every pieces placed on the cross (assuming that our locking mechanism will auto-correct the location if there is a bias on placement) (**100%**)
- Able to check for illegal moves and warn players (e.g. you moved pieces already placed, or you placed your piece onto another placed piece) (**100%**)
- Able to record and synchronize the game state with software (**50ms** latency)

Use Case Requirements (Movement)

- Piece feed system should be on-time and accurate (game piece is shipped to a place where the x-y gantry can pick it up, less than **3 seconds**, within **5mm** of target destination)
- Movement should be accurate (the game piece should be moved to the vicinity of a cross such that the auto-correct location mechanism can fix the piece) (<**5mm** before autocorrection)
- Movement should be on-time (less than **12 seconds** for the longest possible location on the board)
- Locking & Auto-correct mechanism (a game piece within **5mm** will be automatically centered to the cross location within a boundary) □

Use Case Requirements (User Experience)

- Easy setup (easy setup: just login to app and click start game)
- Easy to play (The player only needs to place his/her/their own move onto the board)
- Online play (Able to play with other players online or with another maGomoku board)



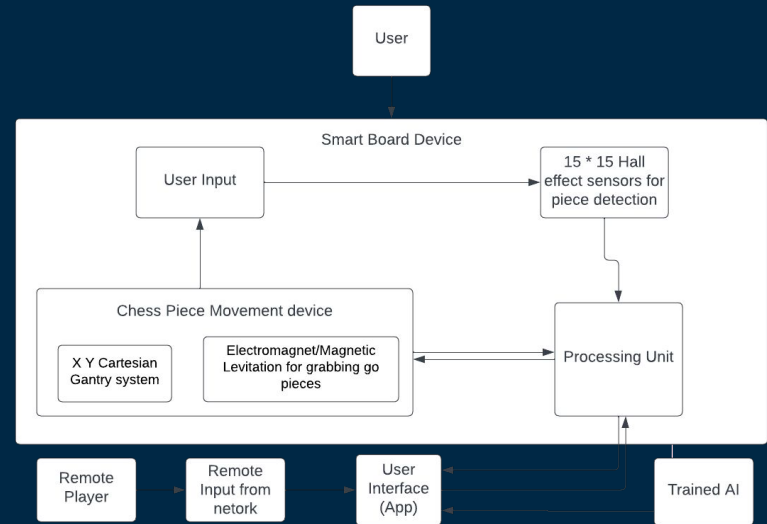
Technical Challenge

1. **Detection:** how to distinct between black and white pieces given that there are externalities like moving magnetic field for moving new pieces
2. **Locking pieces:** how to 'lock' the pieces already placed on board while moving a new piece without **interfering** with the existing pieces and change their locations.
3. **Movement:** how can we make sure that the levitated piece remains levitated while moving and can be placed onto the board with precision.
4. **Interference:** magnetic interference that may affect detection, locking and movement of pieces.

We assume that there is a magate inside every gomoku piece.

Solution Approach

- Existing commercial product for maglev
- Arduino as processing unit for gantry control
- Hall effect sensors for piece detection
- Electro magnet for locking
- Solenoid for feeding
- Flutter for application development
- Opponent api that imitate player movement on <https://papergames.io/en/gomoku>



Testing, Verification, and Metrics

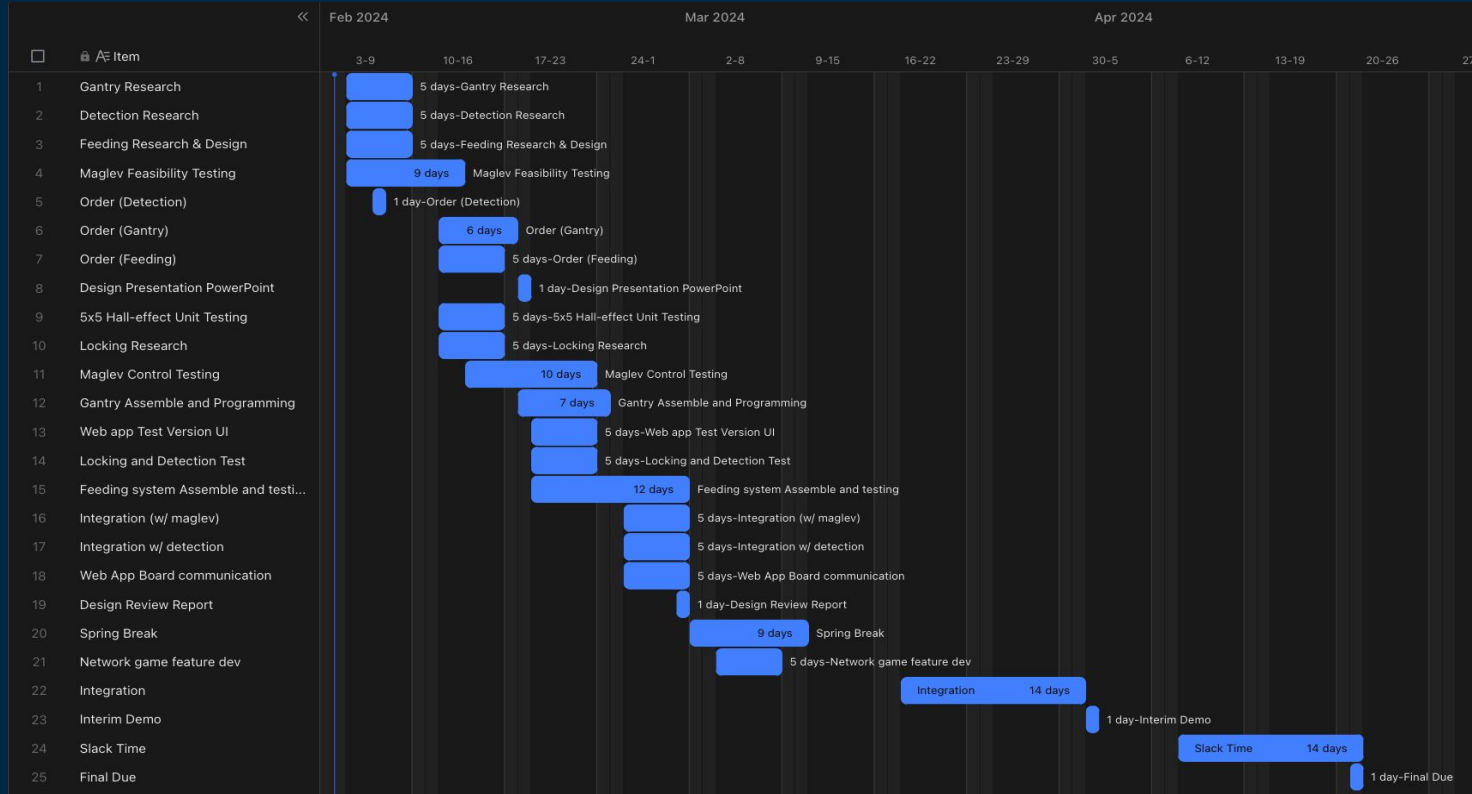
- Board detection correctness test (100%)
- Board state detection test (100%)
- Illegal Move Hardware detection test
- Board state software correctness test (if the software can correctly detects illegal moves based on move history) (100% Cases)
- Piece Auto-correction system test (100% autocorrect piece within 5mm)
- Feeding accuracy test (within 5mm)
- Feeding speed test (3s)
- Piece Movement system accuracy test (95% within 5mm without auto-correction)
- Piece Movement system speed test (delivery within 12s)
- Piece Movement system robustness test (See if the automatic go piece delivery system will lose the piece in movement in response to tremor and magnetic interference) (98% robust delivery)
- User Experience Pressure Testing (Get user feedback to see how fast the system need to go for the user to feel comfortable and not bored)

Tasks and Division of Labour

- Magnetic Levitation device (Chen, Pan, Wan)
- Gantry control & Programming (Wan)
- Detection and Locking Mechanism (Chen)
- Go piece feeding system (Pan)
- Mobile Application development (Pan, Wan)
- Final Integration(Chen, Pan, Wan)



Schedule



THANKS

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