Accessible Chess

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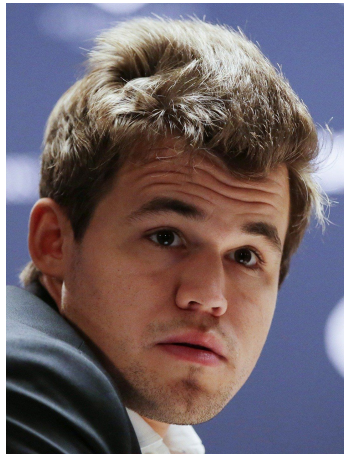
Problem Formulation

- According to World Health Organization, 285 million people worldwide are visually impaired.
- People with vision impairment cannot play chess due being unable to see the board and the pieces on it.
- Results in potentially great players missing out on the chance to learn and play the game.



Solution

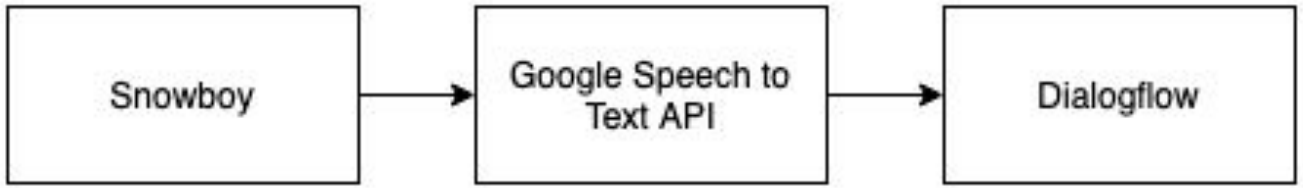
- Link a voice assistant to a chess board
  - Voice assistant accepts and parses command
  - Sends command to chess board
  - Chess board executes command
- Use open source chess board GUI code
  - Saves time
  - Well reputable chess GUI
  - Can modify code as needed

Solution - Voice Assistant

- Problem: Need to convert speech to text
  - Mycroft
  - Jasper
  - Google Cloud Speech to Text API
- Problem: Can’t always take in commands
  - Snowboy Hotword Detection
- Problem: Need to determine which command is spoken
  - Dialogflow

Solution - Voice Assistant

- Final Voice Assistant Solution:
  - Snowboy Hotword Detection
  - Google Cloud Speech to Text API
  - Dialogflow

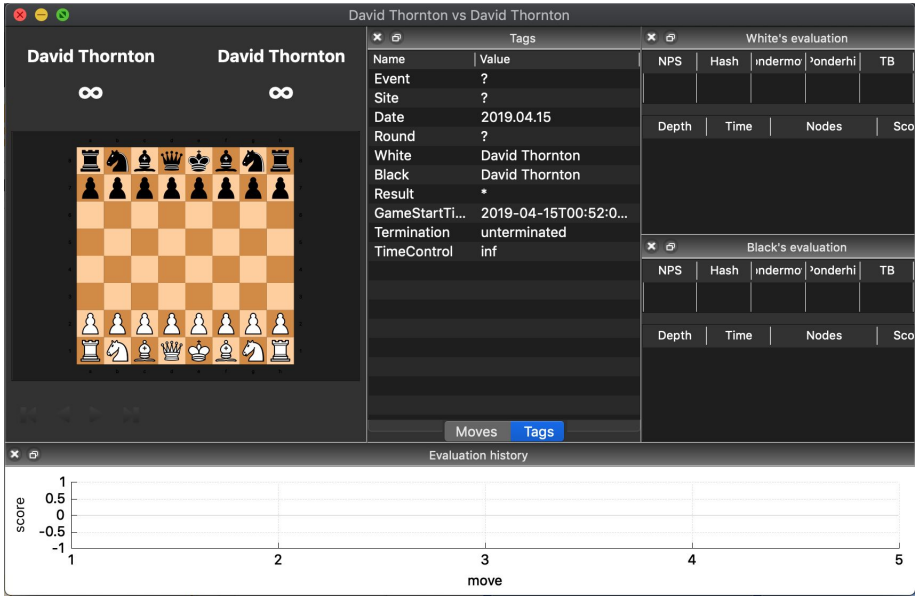


Solution - Embedded Python Interpreter

- Problem: Need voice assistant (Python) and main application/GUI (C++/Qt) to communicate.
- Solution: Embed a CPython interpreter with extensions:
  - Extensions are C++ functions and types usable from Python.
  - C++ code runs Python interpreter in a dedicated thread.
  - Python code calls C++ code to invoke Qt signals and control the GUI.
- Challenges:
  - CPython is single-threaded with a Global Interpreter Lock (GIL); Qt makes heavy use of multiple threads.
  - Reading/mutating Python objects/functions from multiple threads results in a race condition.

Solution - Cutechess GUI

- Open source Chess GUI
  - Released under GPLv3+ and MIT licenses
- Allows work to be focused on voice assistant and embedded python interpreter



Challenges

- Unfamiliarity with technologies used
- Time constraints
- Constraints on libraries used
  - Mycroft currently only supports Linux
  - Text to Speech library has issues on macOS
- Setting up Python packages on local environments
- Hard for speech to be recognized with a lot of noise

Demo

What’s Special

- No other voice controlled chess game on the market
- Fully allows the user to play a match using only voice commands
- Cross-platform

Future Extensions

- Add more chess commands
- Allow users to customize hotword
- Different chess engines
- Screen reader compatibility

What was Learned

- Being able to adapt to changes and new findings is important - Agile development
  - Discovering Mycroft is Linux only
  - Using open source GUI
- Regression testing is important - especially when working on different operating systems
- Use case and class diagrams are helpful when writing code

Questions?

References

Cutechess - https://github.com/cutechess/cutechess (Source code)
Dialogflow - https://dialogflow.com/docs/sdks?authuser=3 (Documentation and Console)
Stockfish - https://stockfishchess.org/download/ (source code)
Google Speech to Text API - https://cloud.google.com/speech-to-text/docs/reference/libraries (Documentation)
Snowboy - https://github.com/kitt-ai/snowboy (source code and how to build)