
EE/CprE/SE 492 BI-WEEKLY REPORT 02

2/8 – 2/21

Group number: sdmay21-05

Project title: AR Chess Advisor

Client &/Advisor: Dr. Joseph Zambreno is both our client and advisor

Team Members/Role:

Dillon Peters: Team Lead

Parker Bibus: Computer Vision Lead

Jake Aunan: Augmented Reality Lead and Tuesday MOM Scribe

Jamie Peterson: Mobile Lead and Thursday MOM Scribe

Aidan Sherburne: Report Manager and Computer Vision Developer

Brett Santema: Testing Manager and Mobile/Glasses Developer

Bi-Weekly Summary: This period the group made significant headway on creating an end to end computer vision pipeline. We found and implemented a python wrapper for stockfish, wrote a method for detecting a single chess piece, wrote a method to determine what color the user is based on the chess board pattern, wrote a function for determining the differences between two FEN notations, continued writing test cases and the testing plan, in addition to minor supporting and organizational tasks. We were able to demo a near complete CV pipeline to Dr. Zambreno, and have set the goal to complete an end to end solution of this pipeline for our meeting with him next Monday.

Past two week accomplishments

- Dillon Peters:
 - Python Wrapper for Stockfish
 - I built off what Aidan had previously started and implemented the remaining wrapper calls in our computer vision python notebook. I also used this time to learn the basic python syntax as I have never done python development before. After implementing the remaining functions and adding comments to them, Aidan looked over the work and it was merged back into the computer vision branch.
 - Python on Android Research and Implementation
 - Researched ways to run python scripts on Android as well as how we would get command line access to install the various python libraries we will need. I settled on the Chaquopy gradle plugin (<https://chaquo.com/chaquopy/doc/current/android.html>) and began implementing it for our needs. I was able to find an example application for calling the python code as well as ways to pass pictures. Currently, we

plan to save the pictures to a file and have the python script read from that file saved on the glasses. However, we can pass as a byte stream or an array if we want to.

- Variety of Organization Tasks
 - Plan the “sprint” and develop meeting agenda, verify and submit Bi-Weekly report, discuss testing plan with Brett
- Parker Bibus:
 - Made minor improvements
 - I updated the values for the red and green color detection to improve the distinction masking between the target colors and non-target colors.
 - Moved the stockfish notebook section from the middle of the computer vision pipeline.
 - Cropped in the perspective shifted image so that the board edges are less pronounced. This improves a few things later in the pipeline as the borders will no longer be in the image.
 - Added a new run mode
 - Added a run mode that loops the pipeline so more than one image can be scanned per run. This gets the pipeline another step closer to having continuous reading from an input device by creating an input agnostic loop.
 - Tested some new images
 - Started some testing on new images that include pieces on them. They have been being scanned pretty well with piece and board detection working well when the tracking dots are visible.
 - Started an implementation of single cell piece detection
 - Added implementation to the check_cell method for figuring out if a single cell is occupied and which color it is occupied by. This is the first iteration that is strictly single pixel color based but is independent enough that it can be updated in the future without affecting the overall pipeline.
- Jake Aunan:
 - Continued to get used to working on the computer vision pipeline the team has developed.
 - Gained a better understanding of color spaces and OpenCV methods for image detection.
 - Began work on using computer vision to determine which side the glasses user is on, black or white.
 - Initial methods used python image detection and manipulation to determine the main colors present in an image. This would then check a space such as the lower left (black square) to determine if the image was primarily black (black piece) or a mix of white and black (white piece on black space)
 - Newer implementation uses our new single cell piece detection to check a cell at the start of the game .
- Jamie Peterson:

- Added settings screen
 - I updated the existing settings screen to be an actual activity so that we can add more settings in the future.
 - Within the settings screen is the difficulty options which can be chosen and will change the level at which the AI plays.
- Added fen difference function
 - I added a new function to the StockfishUtil file that can take in 2 fens and find the difference between them. It then provides a string detailing the difference.
- Researching ways to save battery life
 - Outside of reducing the brightness of our application the best way seems to be to limit how much the camera is on.
- Aidan Sherburne:
 - Stockfish python library experiments
 - Experimented with a variety of different python libraries/wrappers for Stockfish and found the one that best suited our needs
 - Conducted experiments and implemented basic functions and operations to ensure that the library could do what we need, and to understand how it functions. Documented these implementations and prototyped other desired functions.
 - Merged stockfish experiments branch back into primary computer vision branch after sharing my discoveries and getting a green light from the team
 - Minor improvements to existing workflow
- Brett Santema:
 - Research python testing libraries.
 - Produced test games with varying levels of complexity such as basic piece movement, captures, castling, promotion, and different lighting levels.
 - Improvements to image capture for taking test images.
 - Took pictures for testing w/ glasses
 - Set up CV module and basic python tests.

Pending issues

N/A

Name	Individual Contributions	Hours this Period	Total Hours So Far
Dillon Peters	Python Wrapper for Stockfish, Python on Android Research and Implementation	13.5	30
Parker Bibus	Computer vision	8	26

	testing, improving CV pipeline.		
Jake Aunan	Computer Vision/Python experimentation, CV pipeline work	10	20
Jamie Peterson	Difficulty/Settings screen, Fen difference function, battery drain research.	13	23
Aidan Sherburne	Stockfish python integration experiments, computer vision testing and prototyping, improvements on existing workflow	14	26
Brett Santema	Research testing libraries, produced test games, took pictures for testing w/ glasses, set up CV module and basic python tests.	8	10.5

Comments and extended discussion (Optional):

We hope to be able to demo the end-to-end computer vision pipeline next Monday. With a glasses implementation the following week.

Plans for the upcoming week (Please describe duties for the upcoming week for each member. What is(are) the task(s)? Who will contribute to it? Be as concise as possible.)

- Dillon Peters
 - Create PIRM Powerpoint
 - Create the PIRM Powerpoint for talk number one next Thursday. Plan to show this to the team this Thursday or next Monday.
 - Research Recording Python Output
 - Determine how we will pass the output from stockfish back to the android application, and communicate this to the CV team.
- Parker Bibus
 - Finish first implementation of check cell
 - Complete the first implementation of check_cell and ensure that it is working as expected.

- Implement board difference and move methods
 - Implement a method that can compute the difference between the previous board state and the current one
 - Implement a method that takes in this board difference and outputs a method that stockfish is able to read
- Implement pipeline portion to figure out which side we are viewing from at the beginning of a game
- Start passing moves to stockfish (stretch goal)
- Jake Aunan
 - Complete player side detection.
 - Tie player side detection into initial board state setup to begin piece tracking during the game.
 - Set up the pipeline to run easily in a test setup or real setup for use going forward when our modules begin to merge into a full product.
- Jamie Peterson
 - Work on the core gameplay loop for the program.
 - Add in the python communication.
- Aidan Sherburne
 - Continue/improve cell state determination
 - Attempt to determine if we are white/black based on board orientation
 - Improve stockfish initialization depending on which color we play as
- Brett Santema
 - Write out unit tests for CV pipeline.
 - Add more test games for playing as black.

Summary of weekly advisor meeting Our meeting with Dr. Zambreno went much better than the last meeting. We were able to demo a CV pipeline that was much more end-to-end and Dr. Zambreno is pleased with our progress over the period. He believes that we are close to being able to demo an end to end product, and then begin to make iterative improvements over the next couple of months. We have set a high goal to be able to do a full CV demo next week, however this is a very lofty goal and it may be two weeks. A deadline Dr. Zambreno is happy with. Additionally, Dr. Zambreno pointed out that based on the color of the bottom left square, we can determine which color the user is, and we plan to implement that functionality in the coming weeks.