

ECE532 – Digital Systems Design

Live Go Game Recorder (LGGR)

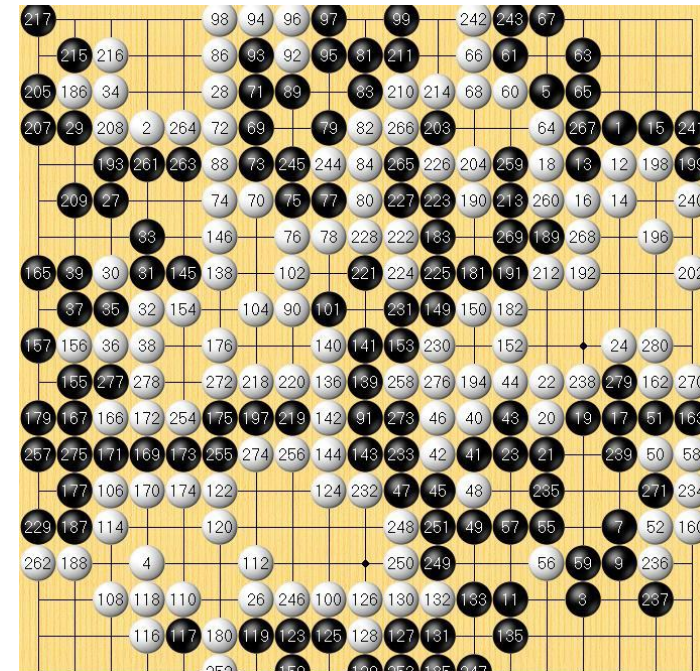
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Background & Motivation

- 60 million Go players in the world^[1]
- Can last more than 400 moves on 19x19 board^[2]

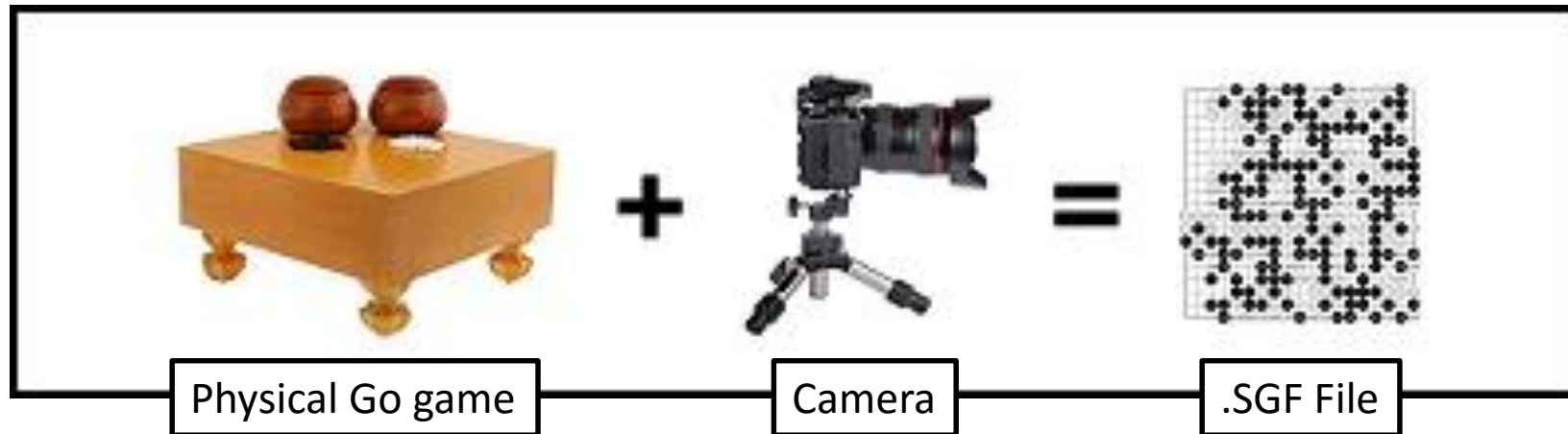


Lee Sedol vs. AlphaGo 5th game

Too many moves to remember for review!

Goals of LGGR

- Main Goal:
 - To “remember” the physical Go game for the players
 - To provide players with the .sgf file



Goals of LGGR

Initial Goals:

- Automatic board detection
- Automatic stone detection
- Hand detection
- Error Checking
- File system on microSD card
- SGF file writer

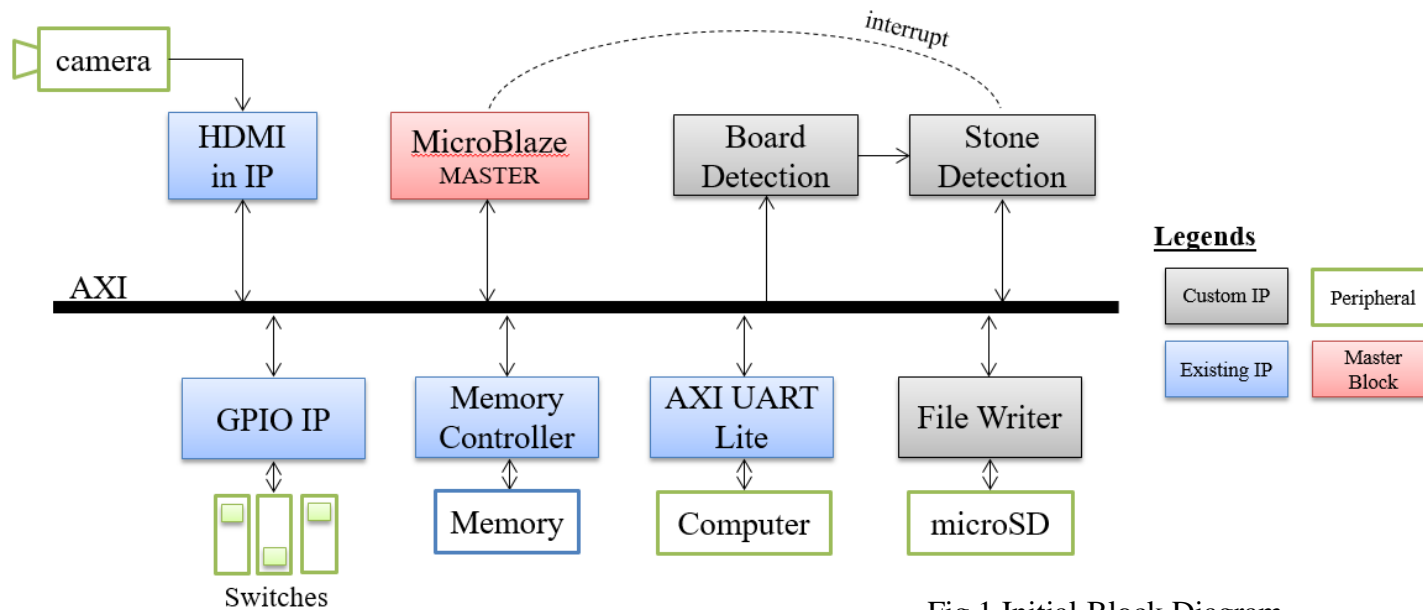


Fig.1 Initial Block Diagram

Results

- 5 out of 6 initial goals were met with some modifications and complications...
 - Automatic Board detection
 - Automatic Stone detection
 - ~~Hand detection~~
 - Error checking to see if legal move has been made
 - Implementation of FAT system on microSD card
 - SGF file writer

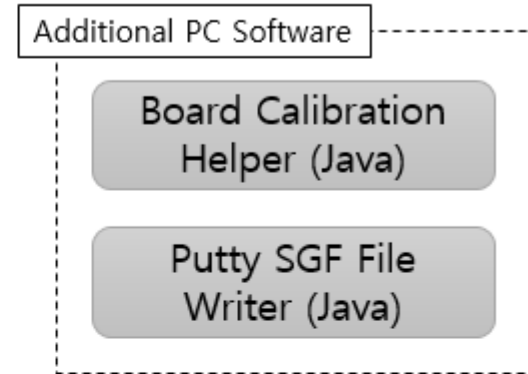
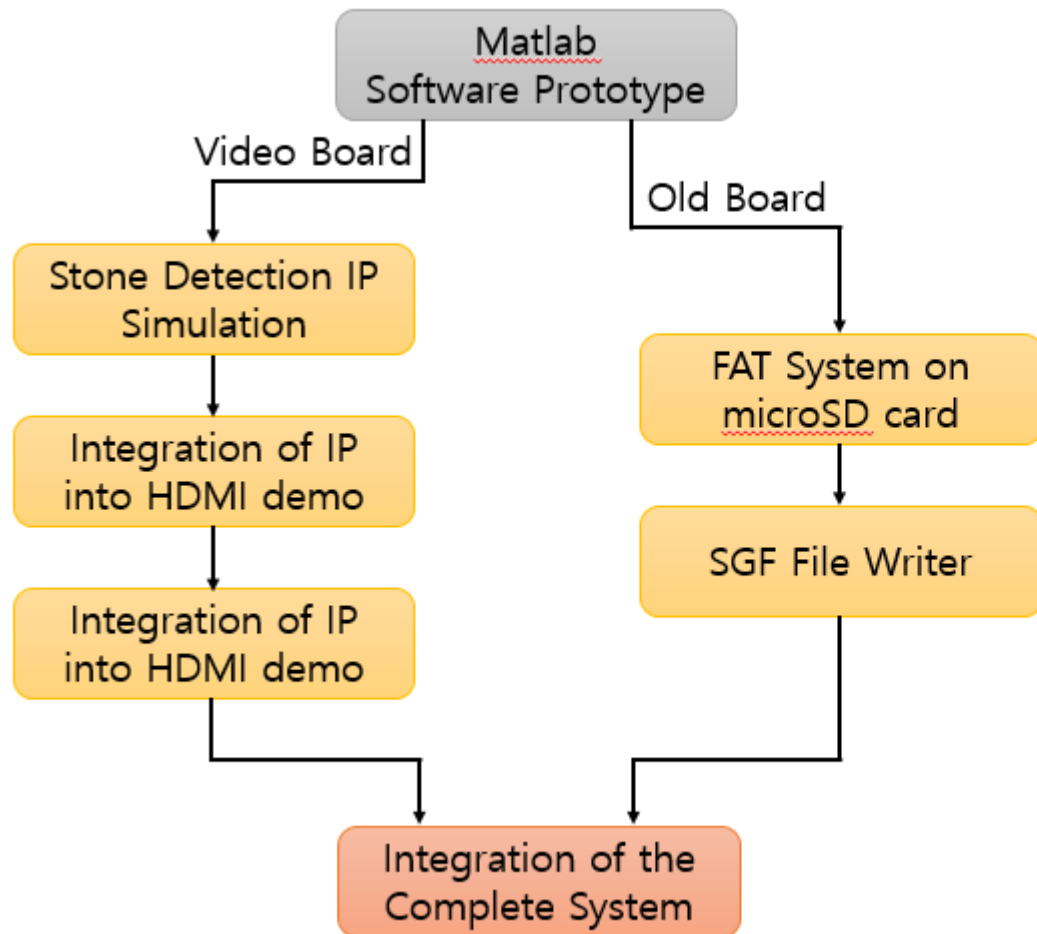
Results

- 5 out of 6 initial goals were met with some modifications and complications...
 - **Manual** board calibration
 - Automatic Stone detection
 - ~~Hand detection~~
 - Error checking to see if legal move has been made
 - Implementation of FAT system on microSD card
 - SGF file writer

Results

- 5 out of 6 initial goals were met with some modifications and complications...
 - Manual board calibration
 - **Semi-automatic** Stone detection
 - ~~Hand detection~~
 - Error checking to see if legal move has been made
 - Implementation of FAT system on microSD card (not integrated)
 - SGF file writer (not integrated)

Design Process



Legend

Finished on Board

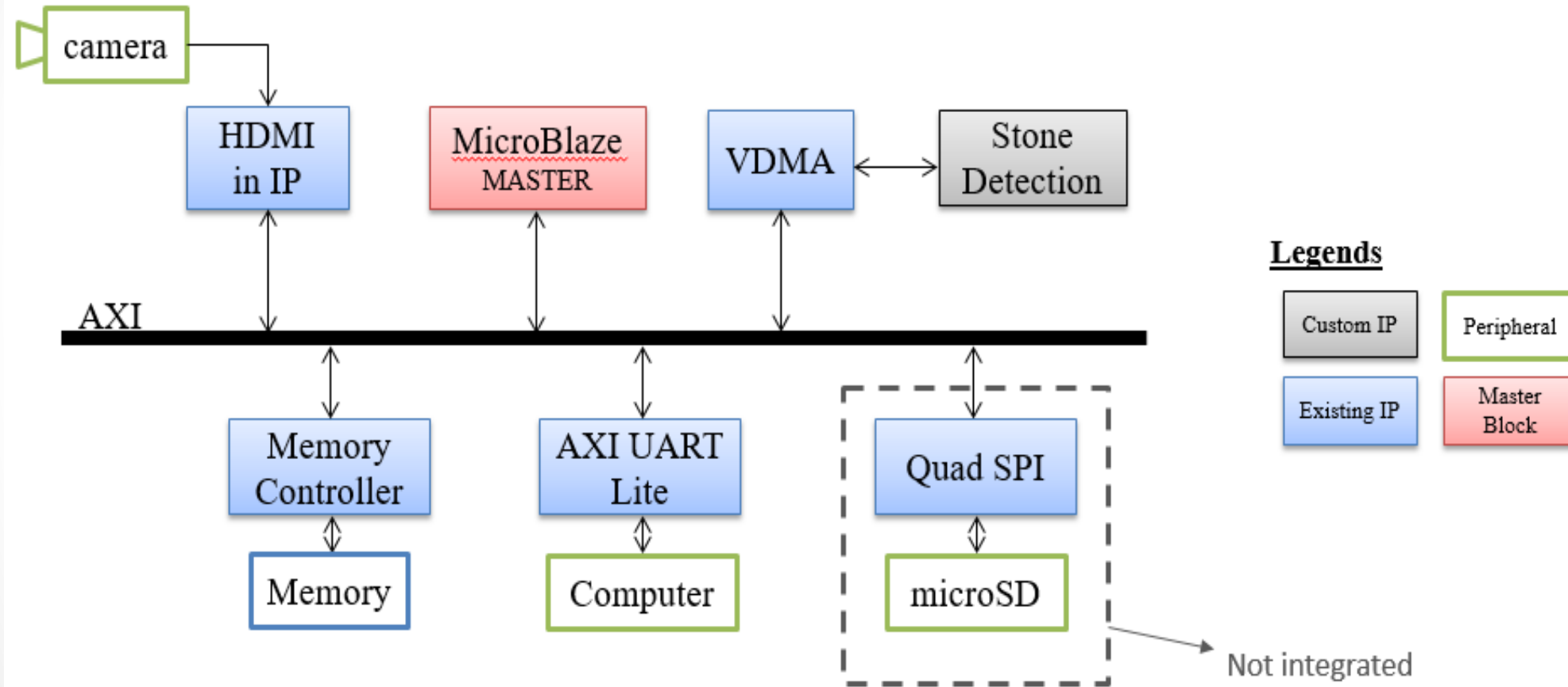
Unfinished

PC Software

Reasons for Modification

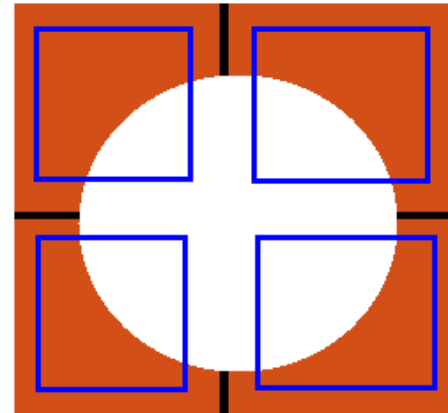
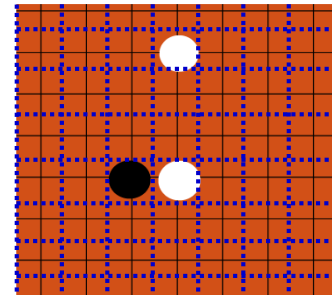
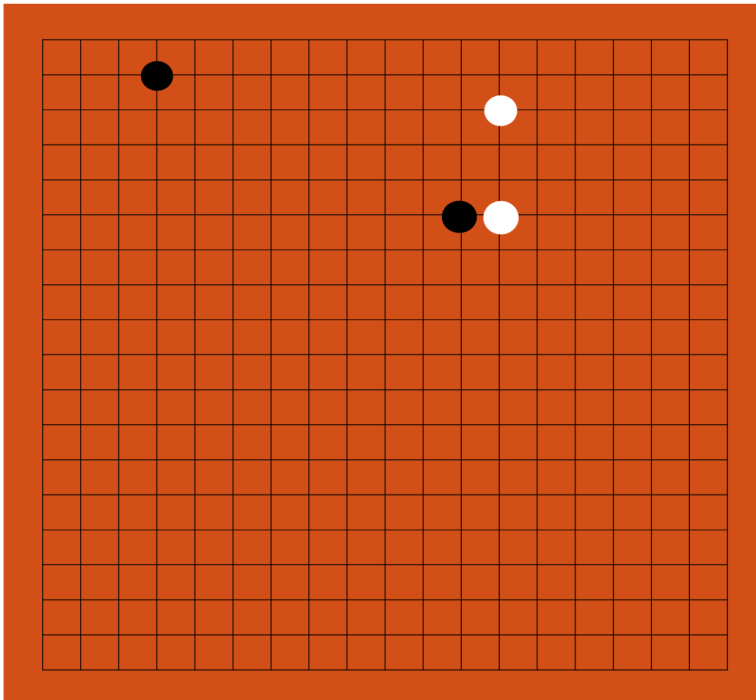
- Time Constraints
 - Time permitting, possible to complete other goals
 - Allotted timeframe did not allow for full implementation
- Difficulties in Integration
 - Differences between boards → difficult to parallelize
 - Modifications to the block diagram could take hours

Revised Block Diagram



Stone Detection

- Division of the region into 19x19 cells
- In every cell minimum and maximum is found
- Points near board lines and neighboring cells are excluded



Performance

- Compared average runtime of LGGR with Go-Getter software^[3]
- Measurement:
 - 13.95 sec / 100 iterations = 139.5 ms

Go-Getter ^[3]	LGGR
350 ms	139.5 ms

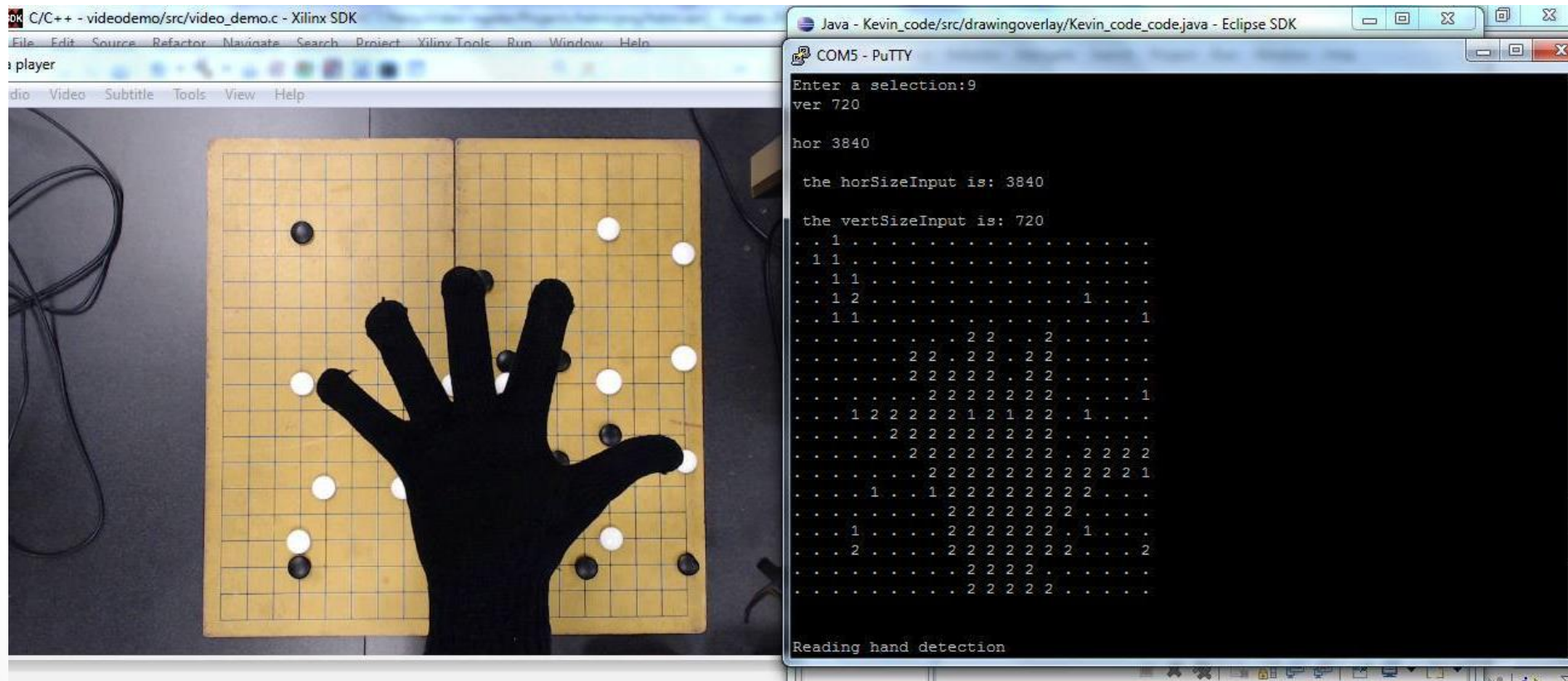
What We Learned

- Integration is non-trivial.
 - Allocate a lot of time for integration
- Modifications to the MicroBlaze code are faster than modifications to Verilog/Block design
 - Design accordingly

Conclusions

- Can be made real time
 - Performance test
 - Potential for memory optimization
- Highly configurable stone detection IP
- Functionality can be easily extended

Thank you!



References

- [1] <http://www.britgo.org/press/faq.html>
- [2] <http://senseis.xmp.net/?NumberOfPossibleGoGames>
- [3] https://www.youtube.com/watch?v=2Jzi2h_dWCE @ ~7:30

Code used in stone detection system

<https://reference.digilentinc.com/nexys-video:start>