C4 - CryptoHash

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Use Case Requirements

Specialized hardware only works for a specific cryptocurrency.

Cryptocurrencies values fluctuate wildly!

Specialized hardware is expensive!

Support at least two proof-of-work coins, Bitcoin and Ethereum.

Our default choosing algorithm will choose the optimal spread of coins.

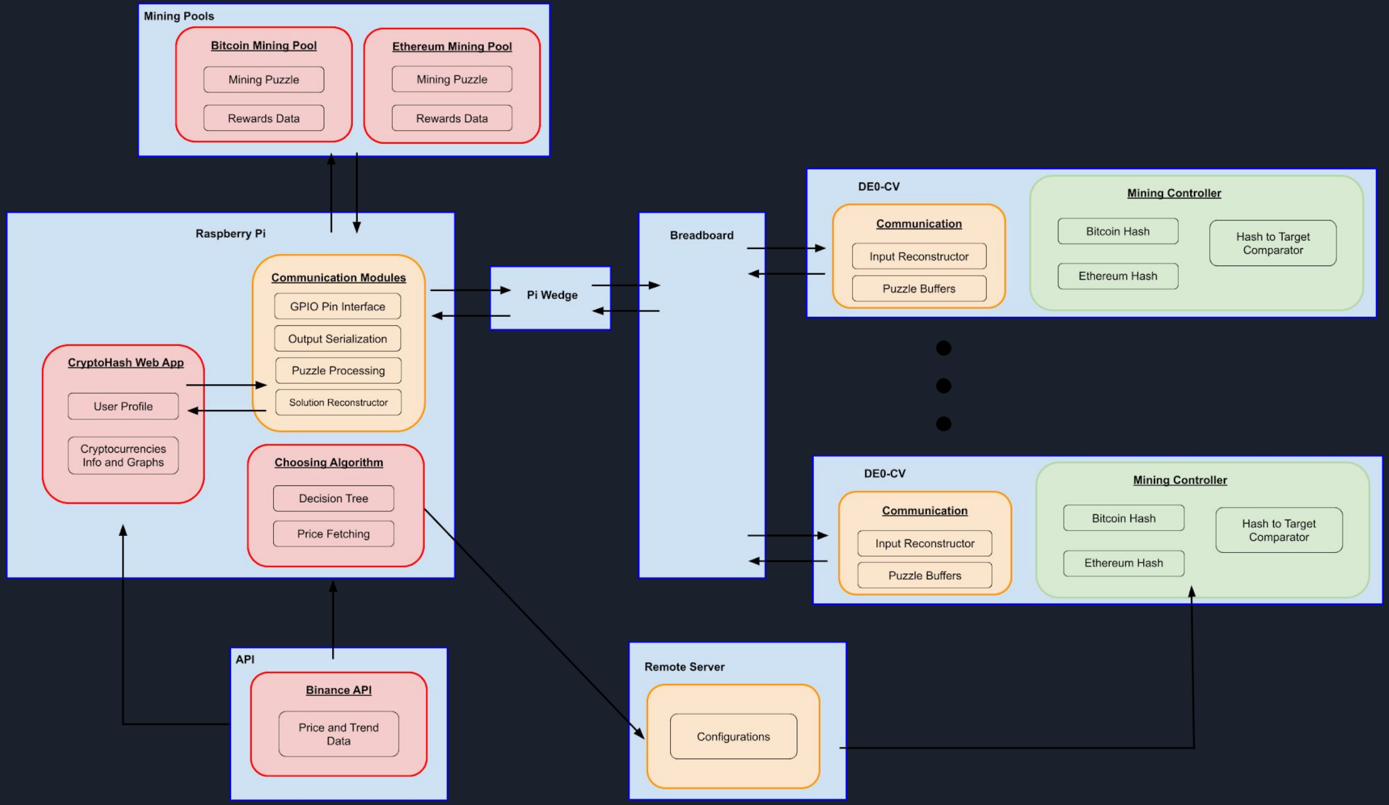
Use Case Requirements

Choosing mechanism needs to pull from current data, trained from price data and trends from the past 3 months.

Consumer-targeted GPUs have a hash rate around five million hashes per second (5 Mh/s). We are looking for at least 90% of this hashing power but with a 10% lower hardware cost, with the goal of turning a net profit.

Communication overhead minimal, configure the new settings within 10 seconds.
Update metrics displayed to the user (hashrate, current prices) every minute.

Solution Approach



Complete Solution

We will have our setup with the Raspberry Pi connected with 10 FPGA boards through the Pi Wedge

The spread changes can be observed by looking at the boards directly

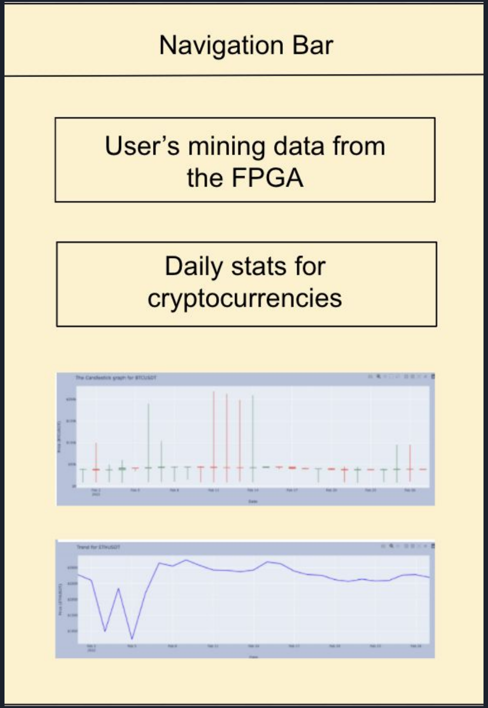
Sample puzzles to quickly show that the miner mines correctly

Complete Solution

WebApp

- Metrics (hashrate, current choice from choosing algorithm, amount mined) displayed to the user and updated every minute.

- Candlestick charts and the line charts for the cryptocurrencies to get a better sense of the trends in cryptocurrency.



Navigation Bar

User's mining data from the FPGA

Daily stats for cryptocurrencies

Test, Verification and Validation

- Bitcoin FPGA Layout

# of Mining Modules	Logic Utilization (ALMs)	Total Registers	Total pins	Hashrate	Power
1	3005 / 18480 (16%)	3518	139 / 224 (62%)	3.8 kH/s	3.1191 mW
8	16459 / 18480 (89%)	21947	139 / 224 (62%)	3.04 MH/s	24.778 mW

Test, Verification and Validation

- Configuration switching time was in-line with what we anticipated
- Our requirements listed a 10 second latency which we were able to achieve for one board
    - Average time was 6.38 seconds
- When switching multiple boards, the amortized time is less than 10 seconds
    - Quartus Programmer can only load one board at a time
    - Requires a redesign of our ML process to change the optimal spread one board at a time to minimize idle switching time

Test, Verification and Validation

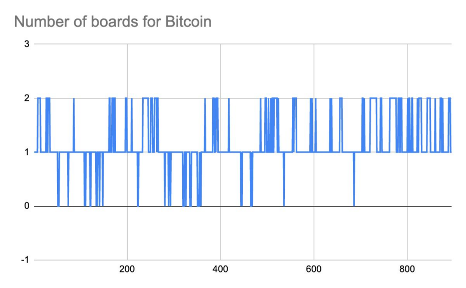
- Scaling a single FPGA board design up to a system of 10 boards results in a hashrate of 30.4 x 10^6 H/s
- F2Pool Bitcoin hashrate is 2.18 x 10^19 H/s.
- Global Bitcoin hashrate is about 2.21 x 10^20 H/s.

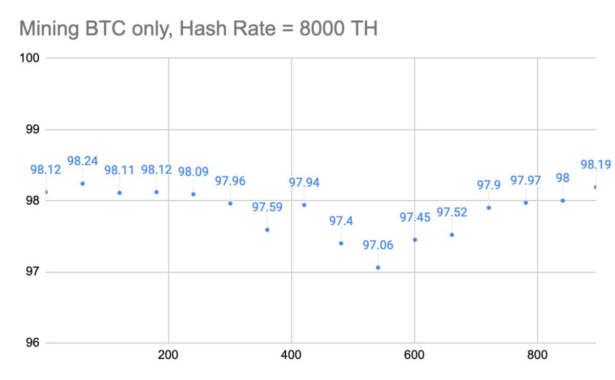
Expected returns per second is 5.67 x 10^-11 dollars per second.

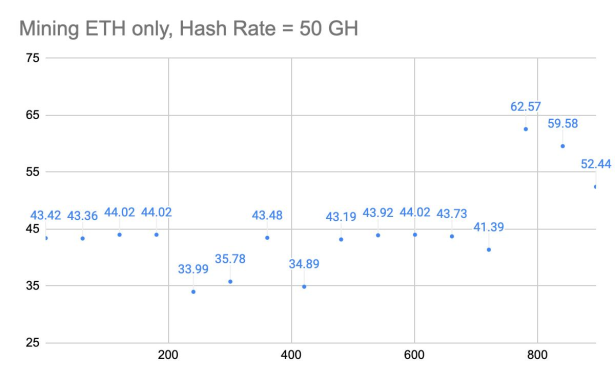
Pittsburgh energy averages $0.0963/kWh. Our energy costs are 6.63 x 10^-9 dollars per second.

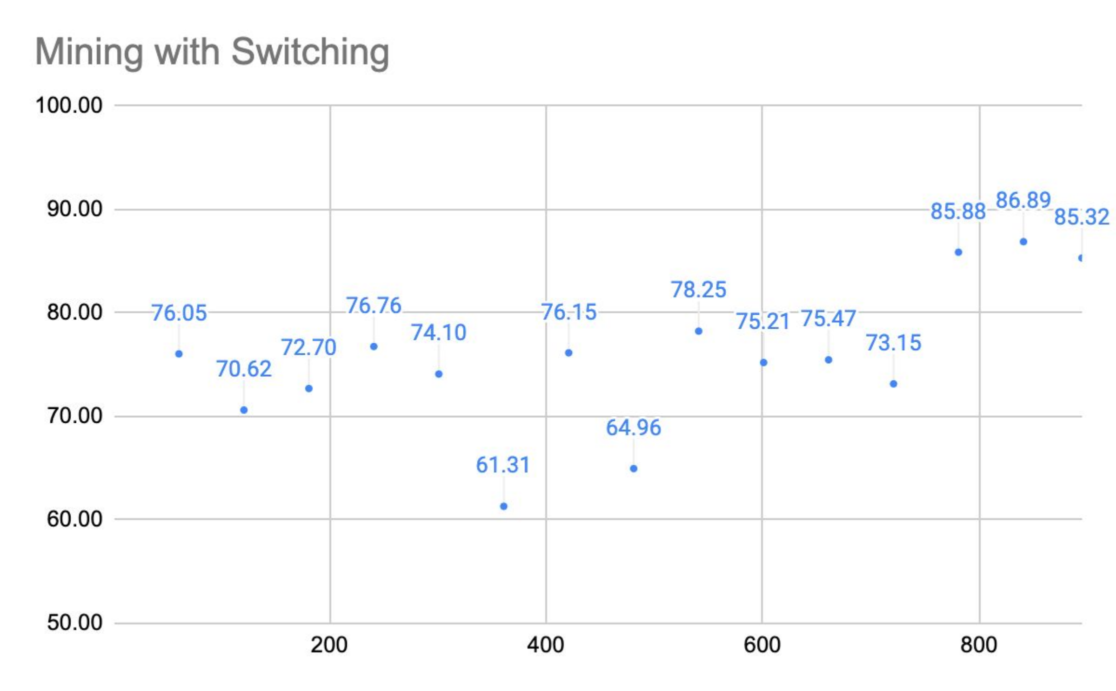
Loss of 6.57 x 10^-9 dollars per board per second.

Test, Verification and Validation


Number of boards for Bitcoin

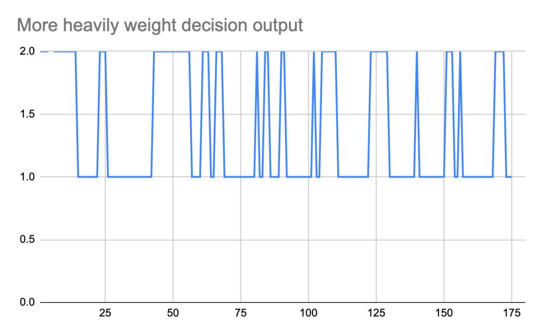

Mining BTC only, Hash Rate = 8000 TH


Mining ETH only, Hash Rate = 50 GH

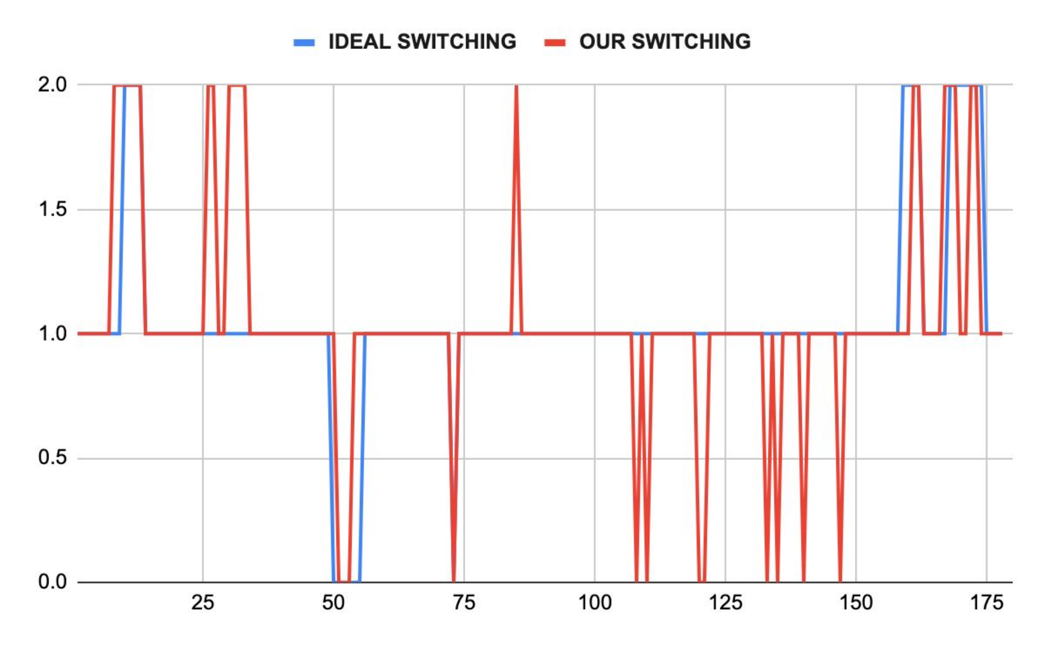

Mining with Switching

Test, Verification and Validation

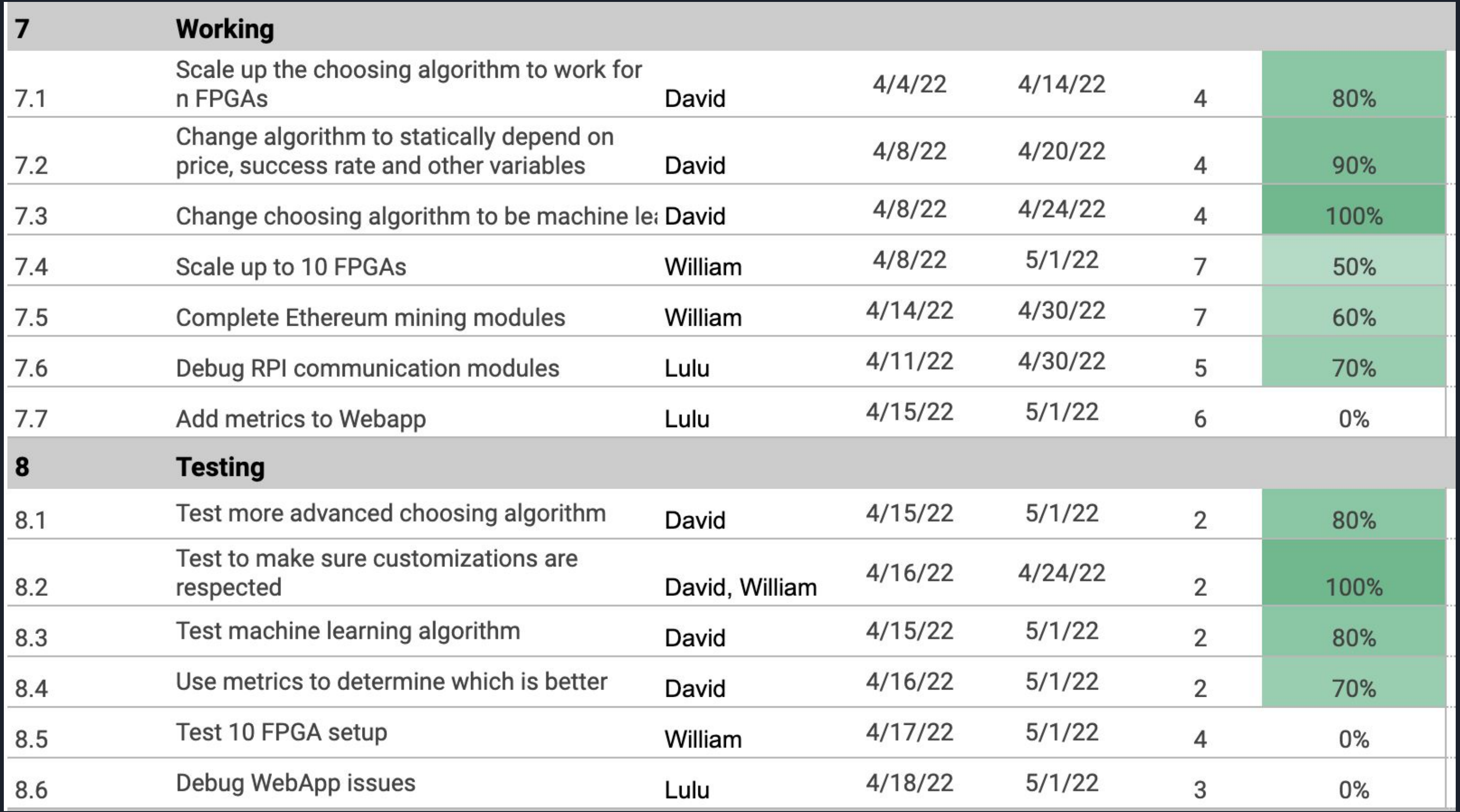
Config	Chooses higher % price inc
Balanced	81.1%
More heavily on transaction volume	80.0%
More heavily on decision output	73.3%
Less heavily on difficulty change	66.1%
More on both transaction and decision	64.4%



85.56% Similarity with Ideal spread



Project Management



7	**Working**					
7.1	Scale up the choosing algorithm to work for n FPGAs	David	4/4/22	4/14/22	4	80%
7.2	Change algorithm to statically depend on price, success rate and other variables	David	4/8/22	4/20/22	4	90%
7.3	Change choosing algorithm to be machine lea	David	4/8/22	4/24/22	4	100%
7.4	Scale up to 10 FPGAs	William	4/8/22	5/1/22	7	50%
7.5	Complete Ethereum mining modules	William	4/14/22	4/30/22	7	60%
7.6	Debug RPI communication modules	Lulu	4/11/22	4/30/22	5	70%
7.7	Add metrics to Webapp	Lulu	4/15/22	5/1/22	6	0%
8	**Testing**					
8.1	Test more advanced choosing algorithm	David	4/15/22	5/1/22	2	80%
8.2	Test to make sure customizations are respected	David, William	4/16/22	4/24/22	2	100%
8.3	Test machine learning algorithm	David	4/15/22	5/1/22	2	80%
8.4	Use metrics to determine which is better	David	4/16/22	5/1/22	2	70%
8.5	Test 10 FPGA setup	William	4/17/22	5/1/22	4	0%
8.6	Debug WebApp issues	Lulu	4/18/22	5/1/22	3	0%