

# A High Frequency Trading (HFT) system over Ethernet using ZYNQ SOC Platform

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## Motivation

- Focus:** To minimize the latency in High Frequency Trading, we are exploring a platform to improve the efficiency of trading using ZYNQ SOC.
- Challenges:** Predicting the market is challenging because the future is inherently unpredictable. thus, the prediction becomes challenging among the investors to invest the money for making profits.
- Implementation of trading algorithms on FPGA is quite challenging.

## Design Methodology

Different Methods to calculate the execution time of trading algorithm over Ethernet Interface

### Software Implementation (PS)

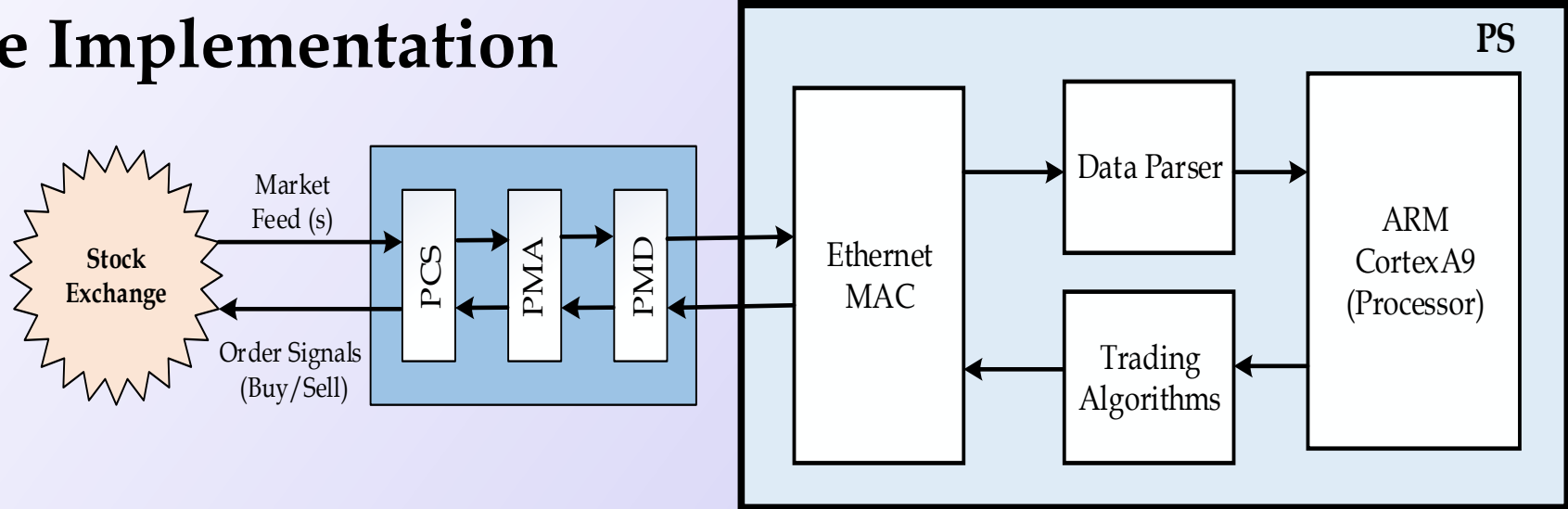


Fig.1 Exchange of Stock Market Data between PS and Stock using Ethernet Mac

### Software & Hardware Co-design Implementation (PS-PL)

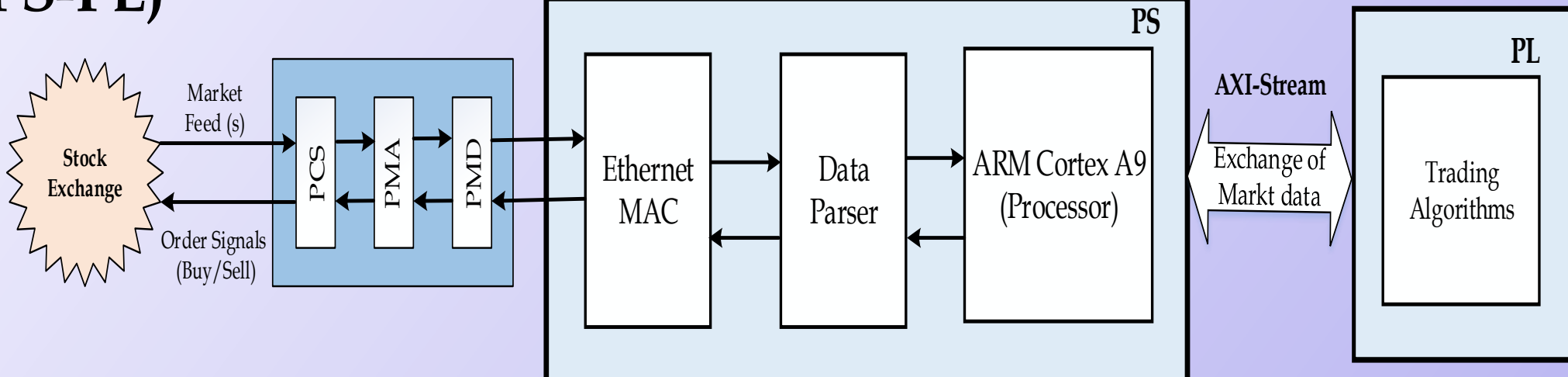


Fig.2 Exchange of Stock market data between PS and PL using AXI-Interface

### Hardware Implementation (PL)

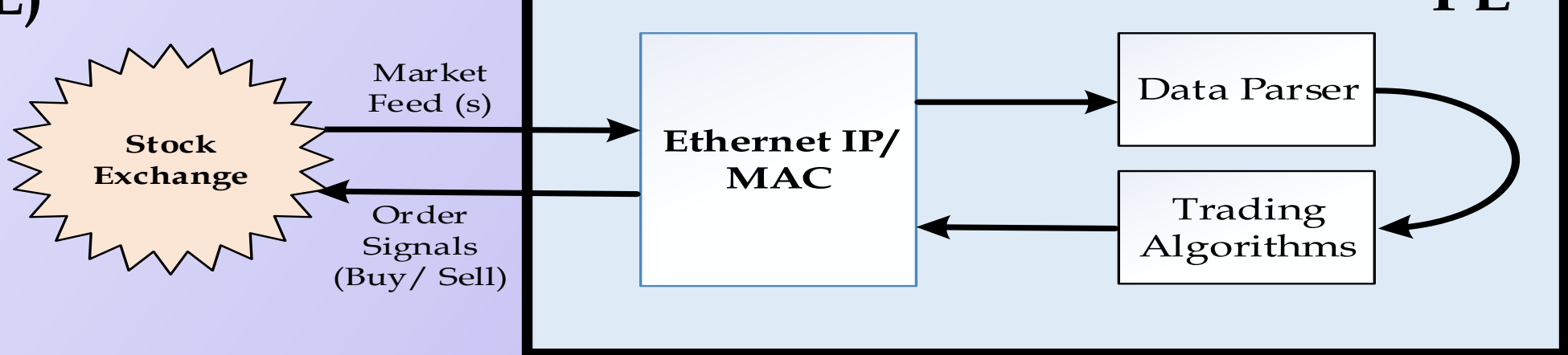
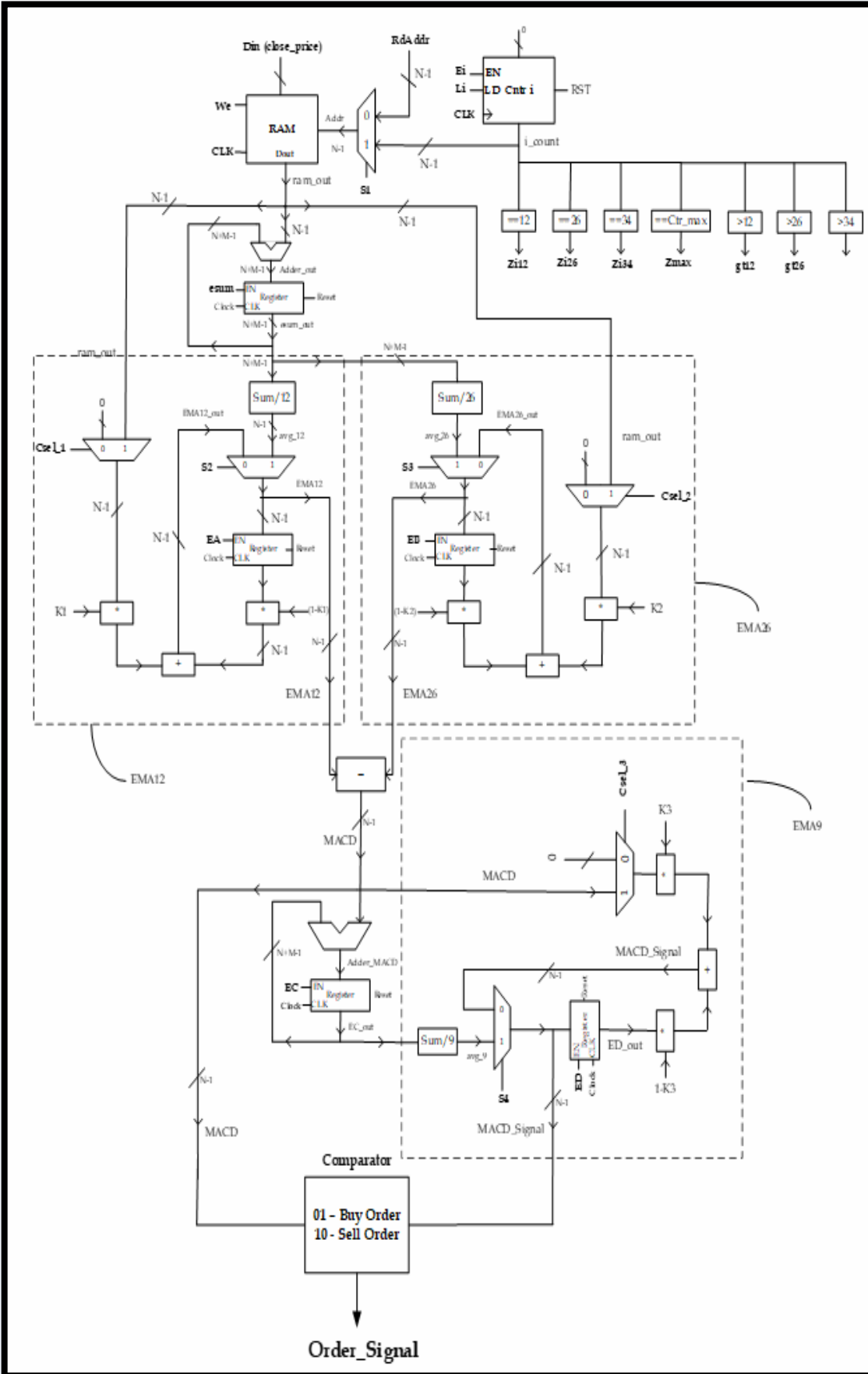


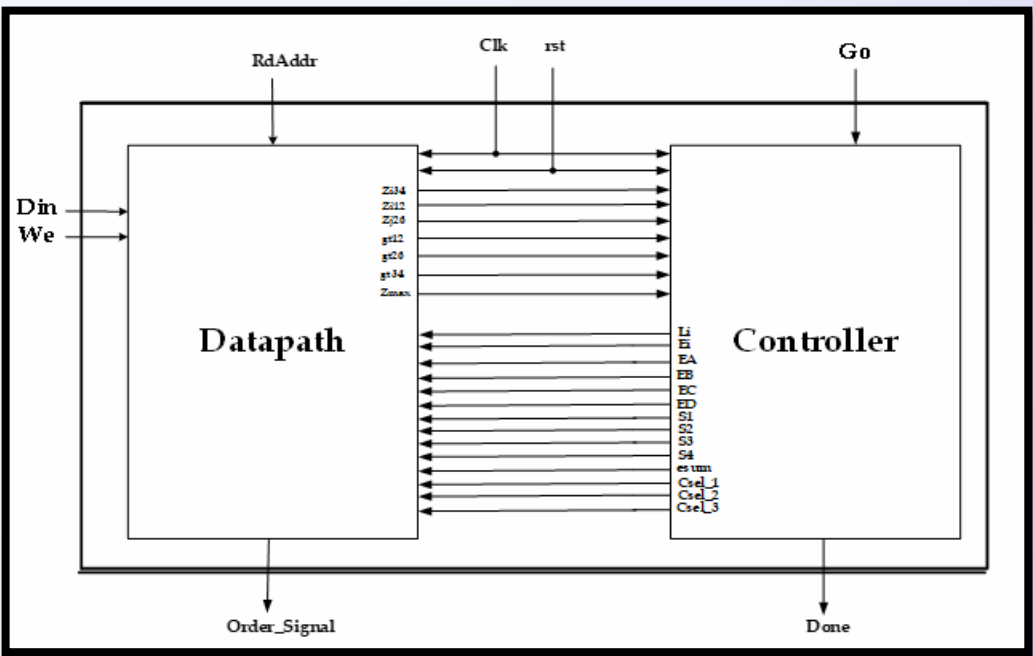
Fig.3 Exchange of Stock Market data between PL using Ethernet Soft IP

### Implementation of Trading Algorithms on FPGA

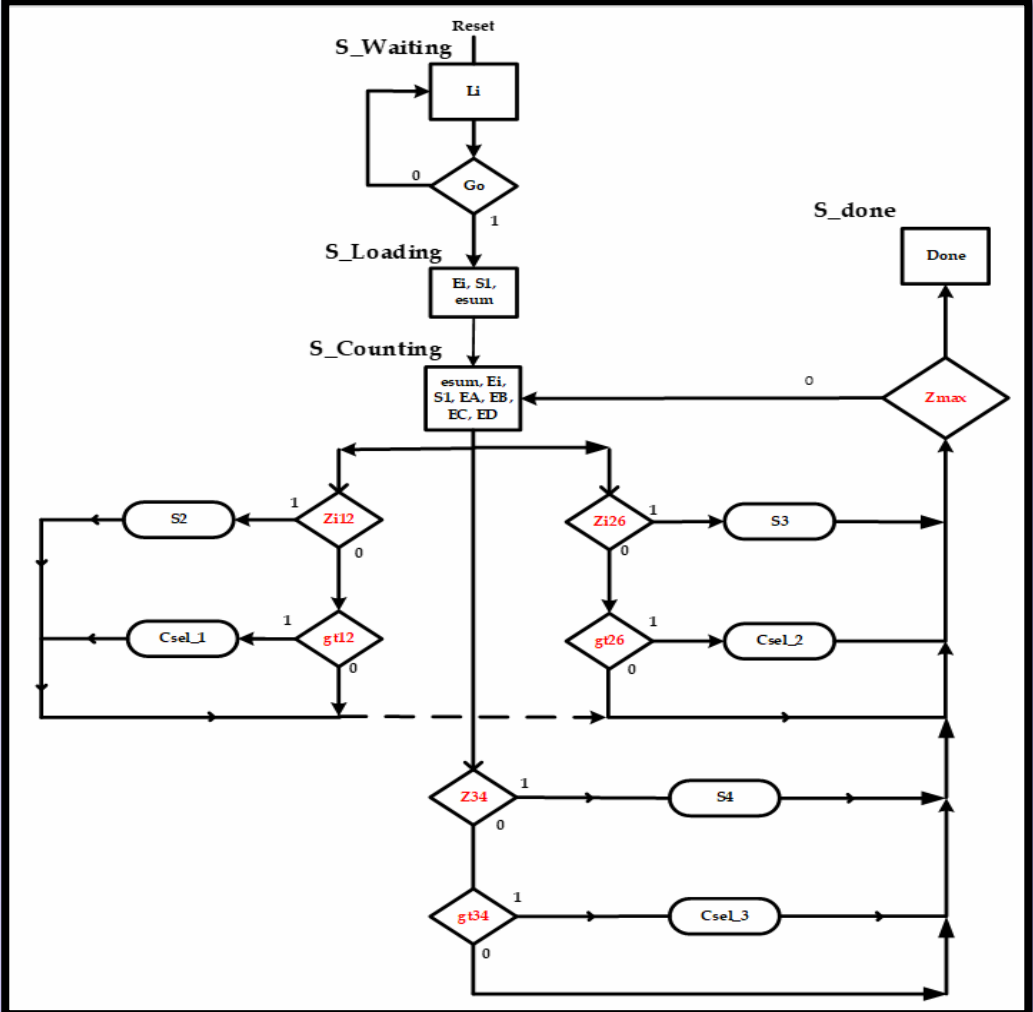
- MACD Algorithm
- RSI Algorithm
- Aroon Algorithm



Datapath (MACD)



Top Level Design (MACD)



ASM Controller (MACD)

## Project Goals

- The general premise of our project is to design a system where hardware and software work together to monitor real-time stock data for many stocks and implement an algorithm to analyze the market to inform a user on whether they should buy, sell, or hold the stock.

## Results & Discussion

TABLE-1 Comparative analysis of Software (PS) and Hardware (PL)

Technical Indicator	Software executional time (us)	Hardware executional time (us)	Latency Comparison
MACD	160 us	8.7 us	H/W=18.6*S/W
RSI	221 us	21.2 us	H/W=10.4*S/W
Aroon	528 us	82.6 us	H/W=6.4*S/W

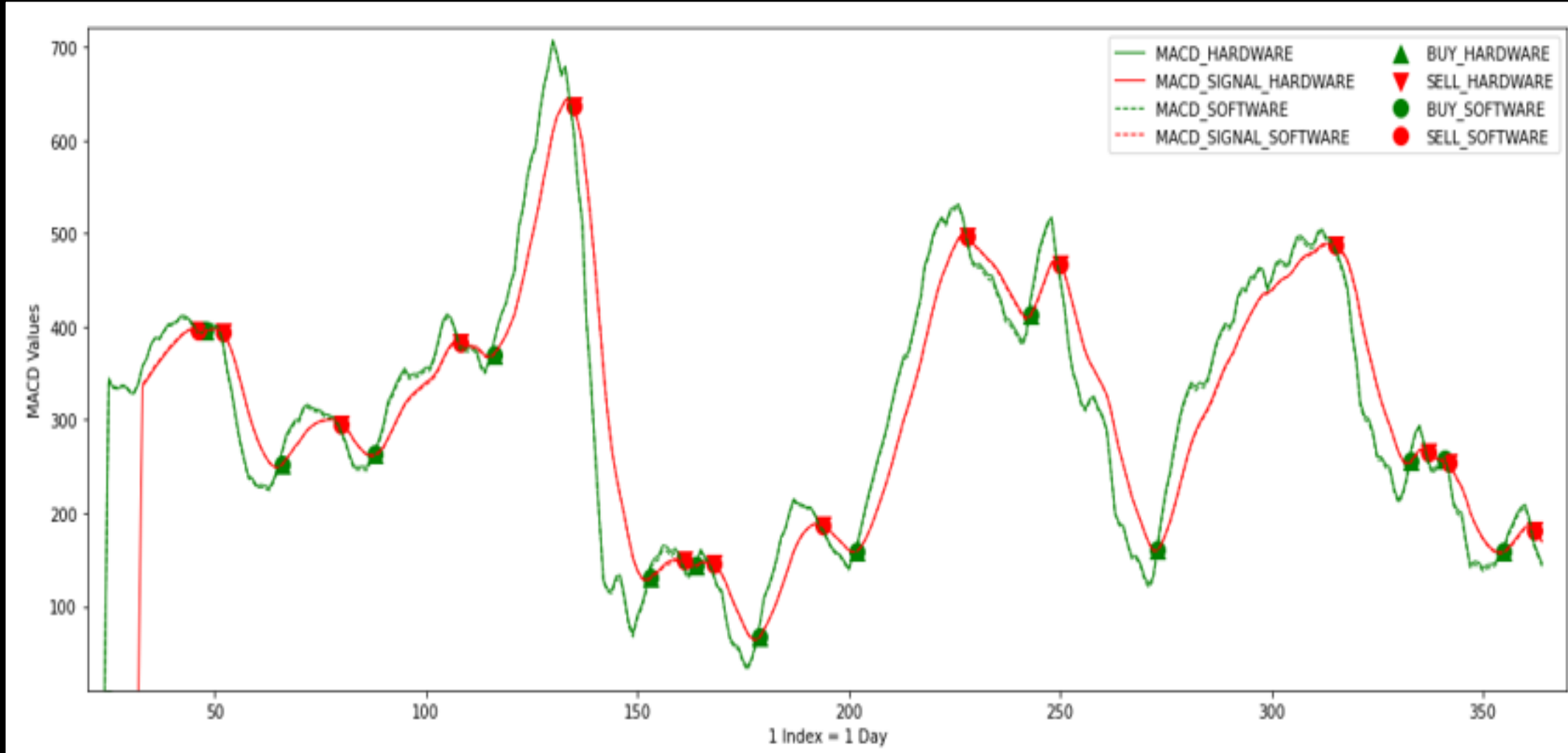


Fig.4 Graphical illustration of MACD indicator predictions on Bitcoin (BTC)

TABLE 2. Cryptocurrency prediction using momentum technical indicators

Crypto Currency	Technical Indicator	Total No. of Trades	Profitable Trades	Non-Profitable Trades	Profitably rate (%)
Bitcoin	MACD	24	19	5	79.1
	RSI	19	14	5	73.7
	Aroon	20	11	9	55
Ethereum	MACD	26	21	5	80.7
	RSI	22	14	8	63.6
	Aroon	22	13	9	59.1

## Conclusions

- In this paper, we concluded that
  - To minimize the latency in High frequency trading, we have to use the ZYNQ SOC platform over 10-gigabit Ethernet to improve the efficiency of the trading.
  - Compare three trading algorithms (MACD, RSI and Aroon) on Bitcoin and Ethereum Cryptocurrencies and concluded that MACD gives the low latency of 8.687 us as compare to other momentum indicators and 16.5 times faster than software while Aroon is the least fast indicator with the latency of 82.56 us but still 6.3953 times faster than software

## Literature Review

Ref	Publication Yr.	Contribution	Results	Demerits
[1]	2021	Technical indicators and ML algorithms are used for stock market prediction	By using each indicator (MACD, RSI) probability of making profit is 50%, if trade is taken for time period of 2 days. As number of days increases profitability also increases.	They didn't implement these trading algorithms on the Hardware Interface like ZYNQ SOC platform over Ethernet
[2]	2021	Deep learning algorithm (LSTM) and technical indicators are used for stock market prediction	In 2019 and in 2020 LSTM (long only) and LSTM (short only) give accuracy of 17.69%,60.76% and 26.49%,59.87% and 66% (81) papers were published based on technical analysis	
[3]	2019	Systematic review of 122 papers related to stock market prediction	The winning rate of MACD and MACD-HVIX is 0.4286 or 42.86% and 0.6667 or 66.67%	
[4]	2018	MACD and MACD-HVIX is used for stock market prediction	Success rate of RSI in each sector is 52.8%, 72.8% and 68.3%. Similarly, Success rate of MACD in each sector is 65.1%, 59.6% and 67.3%	
[5]	2016	RSI, MACD, and Larry Williams %R applied to the Information Technology, Utilities, and Consumer Staples sectors.	Success rate of MACD, RSI and Aroon is 46.76%, 83.33% and 43.57%	
[6]	2015	Six different technical indicators are used in determining the effective buy and sell signal.	Maximum percentage of gain by using MACD and RSI is 34.42% and 30.04%	
[7]	2012	Technical indicators are used for Spanish stock market prediction	The better performance of RSI (1 day period) and RSI (5- and 6-days periods) is 45.65% and 58.61%	
[8]	2010	RSI Indicator and Neural network is used for Improving Trading Systems	The average profitability of MACD indicator with intervals of 12-26-9 is 53.2%	
[9]	2009	Uses of the function of MACD and RVI for monitoring of stock market prices.	Accuracy of MA, MACD, is 33.33% and 54.17%.	
[10]	2008	Comparisons of Stock Rates Prediction Accuracy using Different Technical Indicators		

## Future Work

- Machine learning is more powerful tool than technical indicators. So, that's why in future we want to implement Machine Learning Algorithms on FPGA over 10-Gigabit Ethernet.

## FYP TEAM



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