A Systematic Review of Online Bitcoin Visualizations

Natkamon Tovanich, Nicolas Heulot, Jean-Daniel Fekete, Petra Isenberg

▶ **To cite this version:**

Natkamon Tovanich, Nicolas Heulot, Jean-Daniel Fekete, Petra Isenberg. A Systematic Review of Online Bitcoin Visualizations. Posters of the European Conference on Visualization (EuroVis), 2019, Porto, Portugal. 10.2312/eurp.20191148 . hal-02155171

HAL Id: hal-02155171
https://hal.science/hal-02155171

Submitted on 18 Jun 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

A Systematic Review of Online Bitcoin Visualizations

Natkamon Tovanich[1,3] and Nicolas Heulot[1] and Jean-Daniel Fekete[2] and Petra Isenberg[2]

[1]IRT SystemX, France
[2]Inria, France
[3]Université Paris-Saclay, France

Abstract

We contribute a systematic review of online visualizations of the Bitcoin blockchain. Bitcoin is currently the most active cryptocurrency with the largest market share among other cryptocurrencies. It has attracted a large user base and more and more businesses are beginning to accept Bitcoin as payment. While there are still relatively few visualization research papers on Bitcoin, a growing number of online tools visualize data about the Bitcoin blockchain. We provide a first systematic assessment of these online tools to inform future research efforts on making the Bitcoin blockchain more accessible.

CCS Concepts

• ***Human-centered computing*** → *Visual analytics; Information visualization;*

1. Introduction

Bitcoin is the first cryptocurrency that allowed users to exchange digital currency in a peer-to-peer blockchain-based system without centralized control. Since its first implementation in 2009, it has been widely used and is now the most valued digital currency with currently a ~$7.1B US total market capitalization [Coi19]. Despite its increasing use, Bitcoin is a new technology, difficult to understand in detail, and highly data-intensive. A large number of online visualization-based tools have been made available that are meant to either help Bitcoin users monitor the blockchain or attract public attention to the digital currency. Despite the growing number of online tools, however, visual analytics research tools for Bitcoin are still rare (e.g., [BDP*15, KFI17, YSZ*18]). In order to better understand online Bitcoin visualization tools that could inspire further research, we conducted a systematic review of 46 tools available as of March, 2019. We assessed those tools and classified them according to analysis tasks and visual representations. We provide a summary of the patterns we found among online Bitcoin visualizations as well as a perspective on aspects that are rarely explored and could be addressed in future visualization tools.

2. Bitcoin Background and Related Work

Bitcoin is a cryptocurrency that allows to transfer Bitcoin value between pseudonymous addresses that users create [Nak08]. Transactions are stored in a publicly available dataset called the blockchain. Within the blockchain, transactions are permanently stored in files called blocks. Bitcoin miners verify and validate transactions, group them, and append new blocks to the end of the blockchain.

Bitcoin is the focus of many different types of research, often on technical aspects such as stability, security, and consensus protocols [BMC*15]. We found only one literature review on blockchain *visualization*. Sundara et al. [Sun17] reviewed eight online tools and provided a short description on two criteria: visual representation and implementation. In contrast to our work, they focused on only a small number of tools and other classification criteria.

3. Data Collection

We used the Google Search engine to retrieve Bitcoin visualization tools using a term combination of *Bitcoin* and *analysis*, *analytics*, *visualization*, *visual analytics*, *dashboard*, *graph*, and *chart*. For each term combination, we retrieved the first 100 results and followed the link to each webpage. We retained links to pages that contained interactive graphics accessible to the public. Some search results were articles mentioning Bitcoin visualization tools. In this case, we followed the hyperlink in an article and added it to our list.

4. Result

We found 46 online Bitcoin visualization tools and categorized them into five analysis tasks and five visual representations. The number of tools in both criteria is reported in Table 1. We describe common visualization techniques we found for each analysis task. Figure 1 shows representative examples of tools in each analysis task. Coding tables and screenshots of tools can be found in our supplementary material `https://osf.io/w5b3p/`

Financial transaction tools expose basic statistics on individual transactions, blocks, and Bitcoin users. Most frequently raw data was shown in the form of *text tables* (9 tools in *Others*) with details on addresses, transactions, and blocks [7, 8, 9, 11, 12, 13, 30, 31,

© 2019 The Author(s)
Eurographics Proceedings © 2019 The Eurographics Association.

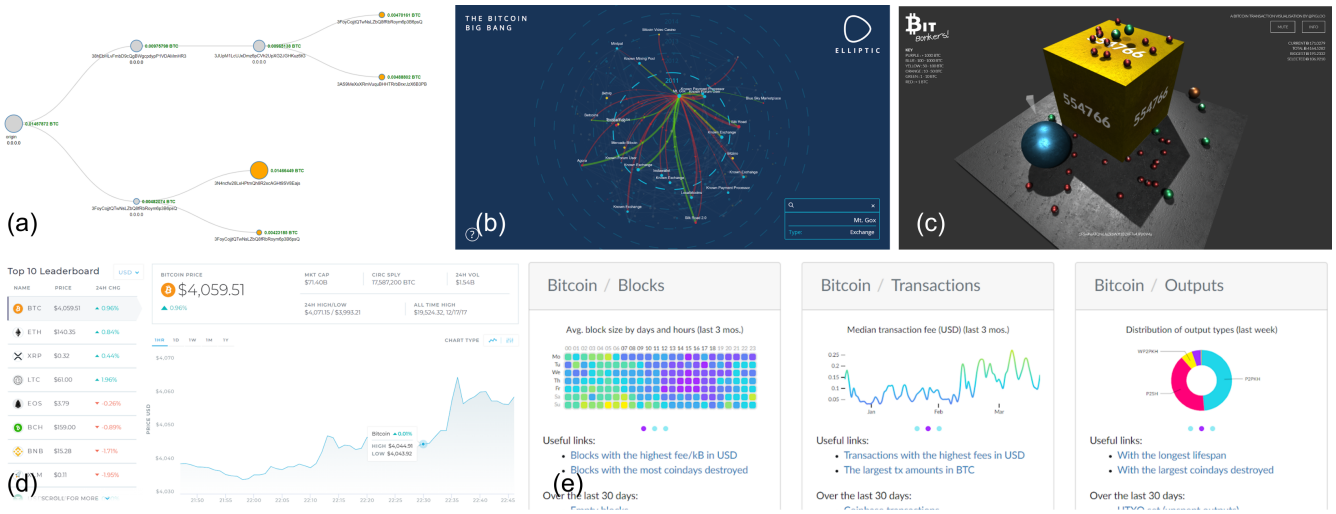

Figure 1: *Examples of online Bitcoin visualization. (a) Financial transaction: Blockchain.info visualizes the flow of Bitcoin money [11]. (b) Transaction network: The Bitcoin Big Bang presents a network of Bitcoin users [24]. (c) Enjoyment/causal uses: BitBonkers shows a data physicalization of Bitcoin [2]. (d) Cryptocurrency exchange: Blockchain.info provides time series showing the exchange rate of cryptocurrencies [11]. (e) P2P network activity: Blockchair uses time series and basic charts to show the Bitcoin network statistics [12].*

Task / Representation	Basic Charts	Time Series	Node-link Diagrams	Maps	Others	Total Tool Count
Financial Transaction	3	5	2		11	13
Transaction Network			4			4
P2P Network Activity	8	11		4		14
Cryptocurrency Exchange	7	17		1	3	17
Enjoyment/casual Use					9	9
Total Tool Count	13	25	6	5	23	46

Table 1: *Number of online visualization tools by analysis tasks and visual representations. Tools may have multiple representations and tasks and, thus, total counts are not sums of rows and column.*

40]. Five tools used *time series* to display the activity timeline of a chosen user, such as the balance and transaction volume [7, 8, 11, 31, 42]. Money flows of transactions were represented as *node-link diagrams* (see Figure 1 (a)) [10, 11], an *adjacency matrix* [36] (in *Others*), and a *Gantt chart-like* [1] (in *Others*).

Transaction network concerns a graph of connections between addresses via transactions. All tools used *node-link diagrams* often with a force-directed layout. Three displayed transaction networks [6, 23, 38] and one a network of Bitcoin users (see Figure 1 (b)) [24]. *Blockchain 3D Explorer* uniquely displays the transaction network in a 3D virtual reality environment [38].

P2P network activity concerns aggregated statistics that give an overview of activities in the peer-to-peer (P2P) network, such as mining, transaction rates, or transaction volume. Eleven tools present network statistics as *time series* [5, 8, 11, 12, 15, 28, 31, 32, 39, 40, 46]. Seven tools used *basic charts* to display non-time series information [8, 11, 12, 14, 15, 31, 40]. Figure 1 (e) presents a dashboard with combination of both charts. We found four tools that show geographical information derived from Bitcoin transactions and network nodes on *maps* both in 2D [15, 46] and 3D [3, 45]

Cryptocurrency exchange presents market statistics, such as historical exchange rate, volume, and market capitalization. Seventeen tools included one or more *time series* (see Figure 1 (d)) [4, 5, 7, 11, 14, 16, 17, 18, 19, 20, 21, 22, 25, 32, 35, 37, 40]. Seven tools used *basic charts* to present market variables for a point-in-time [4, 7, 14, 19, 20, 21, 37]. *Fiatleak* showed live exchanges of Bitcoin to real-world currencies on a *map* [25]. We found *other* visualizations in three tools: a comparative view of market capitalization as a *treemap* [17], multiple crypto-economics factors in a *spider chart* [18], and cryptocurrency trading flows as *Sankey diagrams* [20].

Enjoyment/casual use tools attract the attention of public audiences to blockchain technologies. These tools had unique and experimental representation types. We found data physicalizations on Bitcoin data showing animated live transactions as 2D [26, 27, 33, 41, 43], and 3D representations (see Figure 1 (c)) [2, 29, 34, 44].

5. Discussion and Conclusions

We found a sufficient amount of online visualization tools that focused on financial transaction, cryptocurrency exchange, and P2P network activity statistics. What is still largely missing are tools that allow interested audiences to interactively explore the data based on specific viewpoints such as individual entities in the network, historic events, or network-related events such as halving days or forks. We also see an opportunity for visual analytics tools that help experts detect different groups of Bitcoin users and connect the activities of different groups together.

© 2019 The Author(s)
Eurographics Proceedings © 2019 The Eurographics Association.

References

[BDP*15] BATTISTA G. D., DONATO V. D., PATRIGNANI M., PIZZONIA M., ROSELLI V., TAMASSIA R.: Bitconeview: visualization of flows in the bitcoin transaction graph. In *2015 IEEE Symposium on Visualization for Cyber Security (VizSec)* (Oct 2015), pp. 1–8. doi:10.1109/VIZSEC.2015.7312773. 1

[BMC*15] BONNEAU J., MILLER A., CLARK J., NARAYANAN A., KROLL J. A., FELTEN E. W.: Sok: Research perspectives and challenges for bitcoin and cryptocurrencies. In *IEEE Symposium on Security and Privacy* (May 2015), pp. 104–121. doi:10.1109/SP.2015.14. 1

[Coi19] COINMARKETCAP OPCO, LLC: Cryptocurrency Market Capitalizations. Website, 2019. Last visited: March, 2019. URL: https://coinmarketcap.com. 1

[KFI17] KINKELDEY C., FEKETE J.-D., ISENBERG P.: Bitconduite: Visualizing and analyzing activity on the bitcoin network. In *EuroVis 2017-Eurographics Conference on Visualization, Posters Track* (2017), p. 3. doi:10.2312/eurp.20171160. 1

[Nak08] NAKAMOTO S.: Bitcoin: A peer-to-peer electronic cash system. Published online., 2008. http://bitcoin.org/bitcoin.pdf. URL: http://bitcoin.org/bitcoin.pdf. 1

[Sun17] SUNDARA T.: Study on blockchain visualization. *JOIV: International Journal on Informatics Visualization 1*, 3 (2017), 76–82. doi:10.30630/joiv.1.3.23. 1

[YSZ*18] YUE X., SHU X., ZHU X., DU X., YU Z., PAPADOPOULOS D., LIU S.: Bitextract: Interactive visualization for extracting bitcoin exchange intelligence. *IEEE Transactions on Visualization and Computer Graphics* (2018), 1–1. doi:10.1109/TVCG.2018.2864814. 1

Online Bitcoin Visualization Tool References

1 BATTISTA G. D., DONATO V. D., PATRIGNANI M., PIZZONIA M., ROSELLI V., TAMASSIA R.: BitConeView. Website, 2019. Last visited: March, 2019. URL: http://www.bitconeview.info/.

2 BITBONKERS: BitBonkers. Website, 2019. Last visited: March, 2019. URL: https://bitbonkers.com/.

3 BITCOIN GLOBE: Bitcoin Globe. Website, 2019. Last visited: March, 2019. URL: http://bitcoinglobe.com/.

4 BITCOINCHARTS.COM: Bitcoincharts. Website, 2019. Last visited: March, 2019. URL: https://bitcoincharts.com/.

5 BITCOINWISDOM.COM: BitcoinWisdom. Website, 2019. Last visited: March, 2019. URL: https://bitcoinwisdom.com/.

6 BITFORCE5: BitForce5. Website, 2019. Last visited: March, 2019. URL: http://bitforce5.com/.

7 BITINFOCHARTS: BitInfoCharts. Website, 2019. Last visited: March, 2019. URL: https://bitinfocharts.com/.

8 BITMAIN: BTC.com. Website, 2018. Last visited: March, 2019. URL: https://btc.com/.

9 BLOCKEXPLORER NEWS: Block Explorer. Website, 2018. Last visited: March, 2019. URL: https://blockexplorer.com/.

10 BLOCKSEER: BlockSeer. Website, 2018. Last visited: March, 2019. URL: https://www.blockseer.com/.

11 BLOCKCHAIN LUXEMBOURG S.A.: Blockchain Explorer. Website, 2019. Last visited: March, 2019. URL: https://www.blockchain.com/explorer.

12 BLOCKCHAIR: Blockchair. Website, 2019. Last visited: March, 2019. URL: https://blockchair.com/.

13 CHAINFLYER: ChainFlyer. Website, 2019. Last visited: March, 2019. URL: https://chainflyer.bitflyer.jp/.

14 CIEŚLA K.: Bitcoinity. Website, 2019. Last visited: March, 2019. URL: https://data.bitcoinity.org/.

15 COIN DANCE: Coin Dance. Website, 2019. Last visited: March, 2019. URL: https://coin.dance/.

16 COIN METRICS: Network Data Charts. Website, 2019. Last visited: March, 2019. URL: https://coinmetrics.io/charts/.

17 COIN360.COM: Coin360. Website, 2019. Last visited: March, 2019. URL: https://coin360.com/.

18 COINDESK, INC.: CoinDesk. Website, 2019. Last visited: March, 2019. URL: https://www.coindesk.com/data.

19 COINGECKO: CoinGecko. Website, 2019. Last visited: March, 2019. URL: https://www.coingecko.com/en.

20 COINLIB.IO: Coinlib. Website, 2019. Last visited: March, 2019. URL: https://coinlib.io/.

21 COINMARKETCAP OPCO, LLC: Cryptocurrency Market Capitalizations. Website, 2019. Last visited: March, 2019. URL: https://coinmarketcap.com.

22 CRYPTOWATCH: Cryptowatch. Website, 2019. Last visited: March, 2019. URL: https://cryptowat.ch/.

23 DAILYBLOCKCHAIN: DailyBlockchain. Website, 2019. Last visited: March, 2019. URL: https://dailyblockchain.github.io/.

24 ELLIPTIC ENTERPRISES LIMITED: The Bitcoin Big Bang. Website, 2019. Last visited: March, 2019. URL: https://info.elliptic.co/hubfs/big-bang/bigbang-v1.html.

25 FIATLEAK: Fiatleak. Website, 2019. Last visited: March, 2019. URL: https://fiatleak.com/.

26 HINES C., AKERMAN G.: Federal Bitcoin. Website, 2019. Last visited: March, 2019. URL: https://federalbitcoin.herokuapp.com/.

27 HENDRIKS L.: Bitcoin Transaction Visualization. Website, 2019. Last visited: March, 2019. URL: http://bitcoin.interaqt.nl/.

28 HOENICKE J.: Johoe's Bitcoin Mempool Statistics. Website, 2019. Last visited: March, 2019. URL: https://jochen-hoenicke.de/queue/.

29 INPUT OUTPUT (IOHK): Symphony of Blockchain. Website, 2019. Last visited: March, 2019. URL: https://iohk.io/.

30 JANDA A.: WalletExplorer. Website, 2019. Last visited: March, 2019. URL: https://www.walletexplorer.com/.

31 KATANA CRYPTOGRAPHIC LTD.: OXT. Website, 2019. Last visited: March, 2019. URL: https://oxt.me/.

32 KERSTEIN E.: Bitcoin Visuals. Website, 2019. Last visited: March, 2019. URL: https://bitcoinvisuals.com/.

33 LAUMEISTER M.: BitListen. Website, 2019. Last visited: March, 2019. URL: https://www.bitlisten.com/.

34 MARRUCHO P.: BitcoinCity. Website, 2019. Last visited: March, 2019. URL: http://bitcoincity.info/.

35 MESSARI: OnChainFX. Website, 2019. Last visited: March, 2019. URL: https://messari.io/onchainfx.

36 MCGINN D., MCILWRAITH D., GUO Y.: Bitcoin Blockchain Visual History as Adjacency Matrix. Website, 2019. Last visited: March, 2019. URL: https://www.doc.ic.ac.uk/~dmcginn/adjmat.html.

37 NOMICS: Nomics. Website, 2019. Last visited: March, 2019. URL: https://nomics.com/.

38 SMALL K.: Blockchain 3D Explorer. Website, 2019. Last visited: March, 2019. URL: https://blockchain3d.info/.

39 STATOSHI.INFO: Statoshi.info. Website, 2019. Last visited: March, 2019. URL: https://statoshi.info/.

40 TRADEBLOCK: TradeBlock. Website, 2019. Last visited: March, 2019. URL: https://tradeblock.com/bitcoin/.

41 TX HIGHWAY: TX Highway. Website, 2019. Last visited: March, 2019. URL: https://txhighway.com/.

42 VORNBERGER J.: Bitcoin Monitor. Website, 2017. Last visited: March, 2019. URL: https://www.bitcoinmonitor.com/.

43 WALKER G.: Bitcoinrain. Website, 2019. Last visited: March, 2019. URL: http://bitcoinrain.io/.

44 WILSON R. K.: Bitcoin-VR. Website, 2017. Last visited: March, 2019. URL: https://bitcoin-vr.github.io/.

© 2019 The Author(s)
Eurographics Proceedings © 2019 The Eurographics Association.

45 WIZBIT: Wizbit Realtime Bitcoin Globe. Website, 2019. Last visited: March, 2019. URL: https://blocks.wizb.it/.
46 YEOW A.: Bitnodes. Website, 2019. Last visited: March, 2019. URL: https://bitnodes.earn.com/.

© 2019 The Author(s)
Eurographics Proceedings © 2019 The Eurographics Association.