Process Book: Cryptocurrency Visualizations

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Overview & Motivation

This interactive visualization allows the exploration of the increasing popularity and usage of Bitcoin and its trends relating to other digital currencies, trading volume, and price, since 2011. We explore how various events affect prices, such as the announcement of Mt. Gox's bankruptcy protection, and also how various components of Bitcoin, such as number of transactions and unique addresses link together. We use bar charts, line graphs, a time lapse diagram, and various dropdown options to visually represent these interesting insights.

We decided to choose this project because alternative currencies, specifically Bitcoin, are increasing in popularity and yet the average individual does not understand it. We thought that visualizations showing basic trends about price, volume, transactions, and major events would be beneficial to helping an individual better understand Bitcoin. Neither of us have backgrounds in digital currency, but we are both interested in the topic. Some benefits of visualizing this data include being able to analyze trends over time related to Bitcoin and potentially using it as a tool to predict future trends.

Questions we are trying to answer

- How are price and volume of Bitcoin correlated, if at all? Does it follow typical higher price, higher volume rules?
- How do Bitcoin trading prices change relative to other digital currencies?
- How does news about Bitcoin affect price changes in Bitcoin?
- How are various components of Bitcoin related? Average value and number of unique transactions?

Over the course of the project, our questions changed significantly. These were our original questions from our proposal.

- How do other digital currencies compare to bitcoin in terms of growth, trade volumes, and other metrics over time?
- Do digital currencies exhibit similar trends of emergence and growth or are they independent?
- How does the growth of newer currencies impact the alternative currency market?

It was difficult to find historical data on alternative currencies other than Bitcoin. This forced us to shift our main focus on comparing Bitcoin with other alternative currencies to also comparing different components about Bitcoin, primarily from data we found on Bitcoin Charts. David, our TF, also suggested us more information we could garner from transaction data, such as size, rather than just price data.

Related Work:

Our main visualization was influenced by the basic finance charts on Google finance with Price vs. Time as a line chart and Volume as a bar chart below with brushing/linking enabled. Bitcoin Wisdom, https://bitcoinwisdom.com/, also gave us a better overview of One visualization that influenced us was the line graph with tooltips of major events overlayed on the graph: https://www.tradingview.com/e/wB3NBBLp/Blockchain

Data Collection

Data Sources:

- Blockchain Charts: We grabbed all of the data in the form of CSV files from this site to create our Volume chart as well as other line charts that we overlayed on top of each other from this site. https://blockchain.info/charts
- BitCoin Average: We grabbed Price data for Bitcoin from this site via an API call. https://bitcoinaverage.com/api.htm
- History of Bitcoin data: We grabbed a JSON file of all the major events in Bitcoin history from http://historyofbitcoin.org/.
- Coinplorer: We grabbed historical prices of other digital currencies from https://coinplorer.com/Charts/BTC/USD

Data Processing/Refinement:

The CSV files we downloaded from Blockchain Charts contained dates that were not being recognized. 12/01/13 was not being recognized as dd/mm/yy. We had to refine the data by formatting the CSV files with the same dates. Additionally, instead of having to work with multiple CSV files such as Market Cap, Total Bitcoins in Circulation, and etc, we simply aggregated all the data into one CSV file so that it would be easier to create our graphs with the data later on.

For the historical price data for other digital currencies in Coinplorer, we had to refine the dates given to us in the JSON file. The dates were given as a timestamp and we had to parse this to regular dates so we could use it in our graphs. For example, a timestamp given would be 1387411200. We had to convert this to Thu Dec 19 00:00:00 2013 GMT.

Issues with Data Collection:

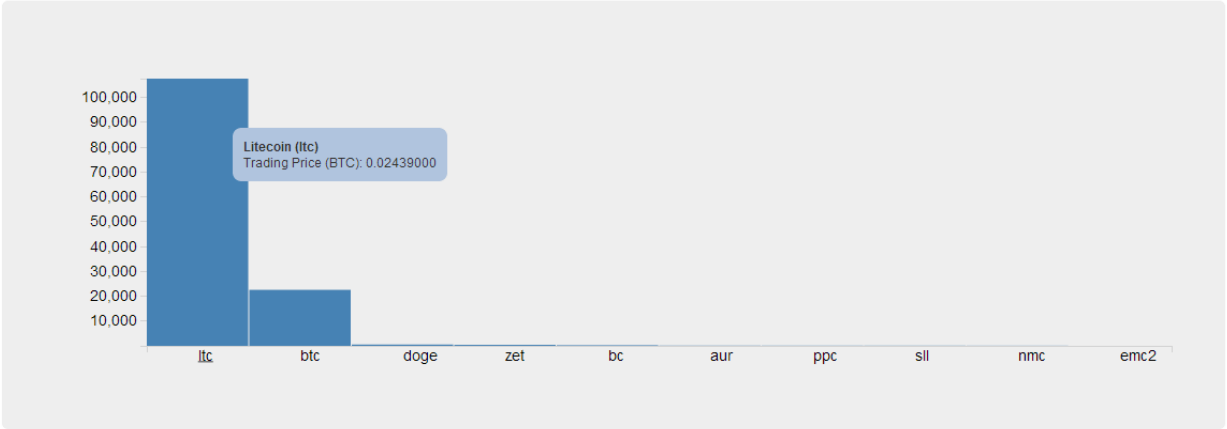
One issue we came across in data collection was that we couldn't find much historical price data related to other alternative currencies. We were able to find various bitcoin charts and statistics on Blockchain, as well some historical price data on Bitcoin Average, but other digital currency data was difficult to find. We found historical price data, but it was difficult to find historical volume data or anything nearly as documented as Blockchain for other digital currencies. Additionally, all the data we needed was not just in one API - for

example, the volume data on Bitcoin Average was not extensive enough so we had to use the volume data on Bitcoin Charts.

Exploratory Data Analysis and Design Decisions:

To look at our data, we first wanted to just see which cryptocurrencies had the highest trading volumes relative to Bitcoin. We thought this would be an interesting first visualization to see for anyone visiting our site so we made it one of the visualizations (see Top Ten Currencies).

One interesting insight we noticed was that Litecoin is actually traded at higher volumes than Bitcoin and in fact, at a much higher volume than any other coin. On the bar chart, Litecoin showed such a significant difference between the other coin volumes that the other bars were not even visible with the scale we were using. This insight made us allow the tooltip to be over the name of the coin and not just the bar since it wasn't always visible.



Another interesting insight we gained from this graph was that Aurora coin, a cryptocurrency only released in Iceland a week ago on March 25th, was already traded at such a high volume.

We actually used this bar chart to determine which were the "important" currencies to download historical price data for and compare Bitcoin to for our other visualizations. We ended up downloading historical price data for DOGE, LITE, MEGA, TRC, and ZETA.

Visualizing Data and Implementation

Initial Design

This was our original visualization. We pivoted from some of our original designs because we thought it made the page too cluttered and we also found that we could learn a lot more from the data we found.

Bar Charts:

- Shows Volume of Trade for Cryptocurrencies in last 24 Hours
  - Bar Charts are a good way of showing rankings.
  - We decided to show only top 10 so that the scale would change and the bars could then become visible.
  - Dynamic tool-tips to display more data about each coin, including actual volume and trading velocity.

As mentioned before in our Exploratory Data Analysis, it was interesting to see that even though most people only hear about Bitcoin, Litecoin actually trades in higher volume.

Price vs. Time Line Chart and Line-O Chart

- Since the BlockChain Chart data set included price and volume data, we wanted to see if price was correlated to volume. We did this by making a price vs. time line graph just to see the general trend first. The trend agreed with our basic intuition that Bitcoin prices pretty much exploded in 2013 and took a huge downfall in 2014, if we looked at the entire timeline of the data.
- We decided that making a line-o chart so that a user could see the actual points and hover over them with dynamic tooltips would be useful. The line graph is useful for understanding the trend, but the line-o chart is more useful for understanding more of the details.
- Justification for design: At first, we choose blue dots on a red line because they were very contrasting colors and made it easily distinguishable.

- However, we then realized that we wanted to be able to see how both prices and volumes increased and decreased day-to-day by using color. An increase would be green, and a decrease would be red. This way, it would also be easier to match each data point in the line graph with the volume bar.
- Additionally, we decided to trim the data to only 2013-2014 because that was where most of the more interesting trends were occurring and because the other historical price data we collected was also within 2013-2014.

Dynamic Tooltips

- The use of tooltips in our visualization incorporates details-on-demand and goes beyond just a simple display of data. Upon mouseover of any point, the tooltip displays the appropriate price, date, and volume. This makes it easier to directly compare price and volume. The earlier data points have a trading price of 0.
- Justification: Tooltips have a light blue background with black text, which we found easy to read.

Volume Bar Chart

- Similar to the Price vs. Time Line Chart, we decided to show how both prices and volumes increased and decreased day-to-day by using color. An increase would be green, and a decrease would be red.

Brushing/Linking

- In order to better understand how price and volume are linked together, we enabled brushing and linking. We added a mini visualization of the price vs. time graph on top so the user could select the time period they wanted to zoom in on, and then the bigger price line chart and the volume bar chart would adjust accordingly.
- Insight: It seems that price and volume are positively correlated. We used brushing and linking to zoom in on the time period of September 2013 to April 2014. In November 2013, we can see from the line graph that there seems like there is huge increase in price, and from the volume bar chart, we can see that there is a general upwards trend because there are many green bars. Similarly, in January 2014 to April 2014, there is a negative trend in price, as well as many red volume bars that show an overall negative trend. **We can conclude that price and volume seem to be positively correlated.**

Events Dropdown

- One question we wanted to answer was how major events in the news affected changes in the price and volume of Bitcoin.
- We first used the events.json we pulled from historyofbitcoin.org and plotted these points onto our price and volume charts to see how they fit into the timeline. When a user clicks

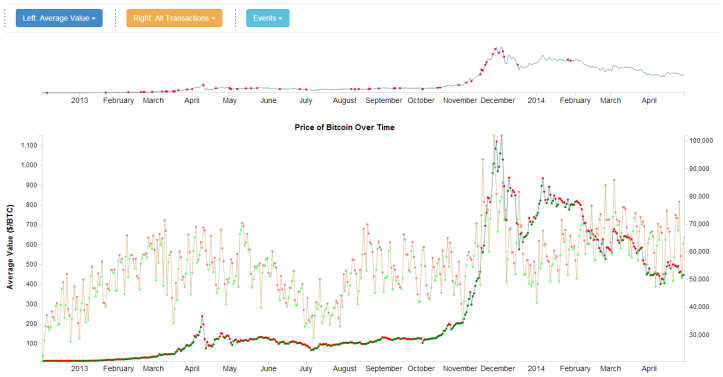
on one of the events, we allowed for the event to automatically zoom into a time range that allows the user to easily understand how the event fits into the timeline. The details about the event are shown on the right hand side so that the user can learn more about the event. We thought just doing another hover over would make it too crowded, so we decided to use the space on the right hand space.

- **Insight:** Going through our events, we notice that when there is a big news event such that Bitcoin reaches an all-time high, like in 2/22/2013, Bitcoin reaches $30 USD, people stop buying and volume decreases significantly, even though we would typically expect people to buy more. Additionally, in 4/10/13, when there was a Bitcoin bubble, volume dropped by 300% over the course of a week.

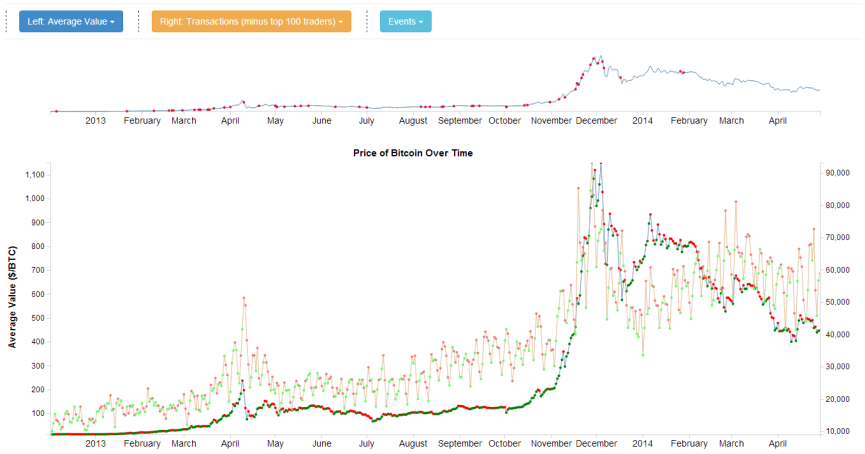
Toggling Two Charts

- One of the questions we are interested in is seeing how various components of Bitcoin are related. We decided to show this by overlaying charts to show interactions between them and have the user be able to choose which two charts they want to compare via toggle buttons.
- We decided to work with a left axis and a right axis as the two y-axes of the two charts to make it easier to overlay the two graphs.
- **Insight:** Playing around with our overlay graphs, this is our conclusion. The number of unique Bitcoin transactions is not directly correlated with average value of Bitcoin, but the number of unique Bitcoin transactions minus the number of top 100 traders is directly correlated with the average value. This tells us that the top 100 traders aren't people who are actively investing in the market, just people who use it as a digital currency. Additionally, we can see that unique addresses is always increasing, which was expected.

Average Value vs. Number of Unique Transactions (not correlated)



Average Value vs. Transaction Value (minus top 100 traders) significantly correlated

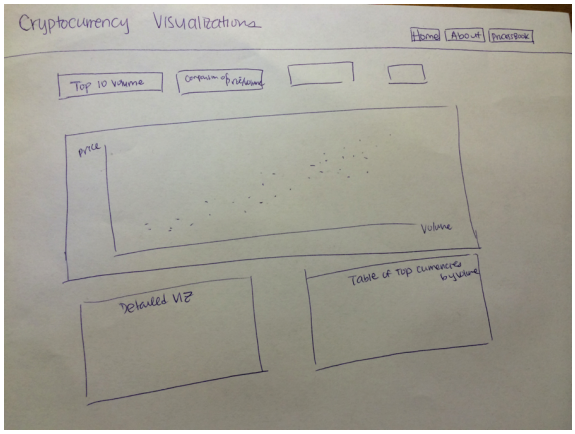


Time Lapse Diagram

- How do Bitcoin trading prices change over time compared to other digital currencies?
- Instead of just showing another line graph to demonstrate how Bitcoin prices compare to other digital currencies, we decided to use a time lapse diagram that has force-like properties (in that it's sticky) where the radius of a circle is proportional to whatever graph type you select. For example, if you choose average value from the dropdown, the larger the price, the larger the radius of the circle. We decided that seeing this visually would be more interactive and more engaging for the user.
- The historical price data we gathered for the other currencies didn't start until 2013, so in the time lapse diagram, some of the circles don't show up until later.
- **Insight: Bitcoin prices change at a faster pace compared to other digital currencies.**

Website Design:

At first, we were just going to have all the visualizations on one page, as the image shows below. However, we decided to add left and right hand columns to make it easier for the user to use our website. The left hand column allows us to choose different modes, and the right div column would contain any detail visualizations we had. The top of the html body would contain the toggle buttons and events dropdown list.. We decided to use bootstrap so that our site would be responsively designed/optimal for mobile.



Evaluation:

In summary, we learned several things from our visualizations.

1. Litecoin is traded in higher volume than Bitcoin.

Answers the question: How does Bitcoin trading volumes compare to other digital currencies? We actually used the top 10 bar chart to determine which were the “important” currencies to download historical price data for and compare Bitcoin to.

2. Price and volume are positively correlated.

Answers the question: How are price and volume of Bitcoin correlated, if at all? Does it follow typical higher price, higher volume rules? By using brushing and linking with our price and volume charts, we saw that general upward trends in price are linked with positive trends in volume, and that negative trends in price are linked with negative trends in volume.

3. The number of unique Bitcoin transactions is not directly correlated with average value of Bitcoin, but the number of unique Bitcoin transactions minus the

number of top 100 traders is directly correlated with the average value. This tells us that the top 100 traders aren't people who are actively investing in the market, just people who use it as a digital currency.

Answers the question: How are various components of Bitcoin related? We used our overlay graphs to come to this conclusion.

4. Not all major events affect Bitcoin prices, but if a well-known company invests in Bitcoin or if there is a major crash, there will be a large effect on price.

Answers the question: How does the news affect Bitcoin prices? Going through our events, we notice that when there is a big news event such that Bitcoin reaches an all-time high, like in 2/22/2013, Bitcoin reaches $30 USD, people stop buying and volume decreases significantly, even though we would typically expect people to buy more. Additionally, in 4/10/13, when there was a Bitcoin bubble, volume dropped by 300% over the course of a week.

5. Bitcoin prices change at a faster pace compared to other digital currencies.

Answers the question: How do prices of Bitcoin change over time compared to other digital currencies? We used our time lapse diagram to come to see how Bitcoin prices change overtime.

Overall, our visualizations actually allowed us to make some important, interesting conclusions. Our visualization works well. To further improve it, we could have added additional detail visualizations that tell us more details about what happens on a specific day, such as number of transactions or transaction size.