

Stock Wars: Elon Musk vs COVID-19

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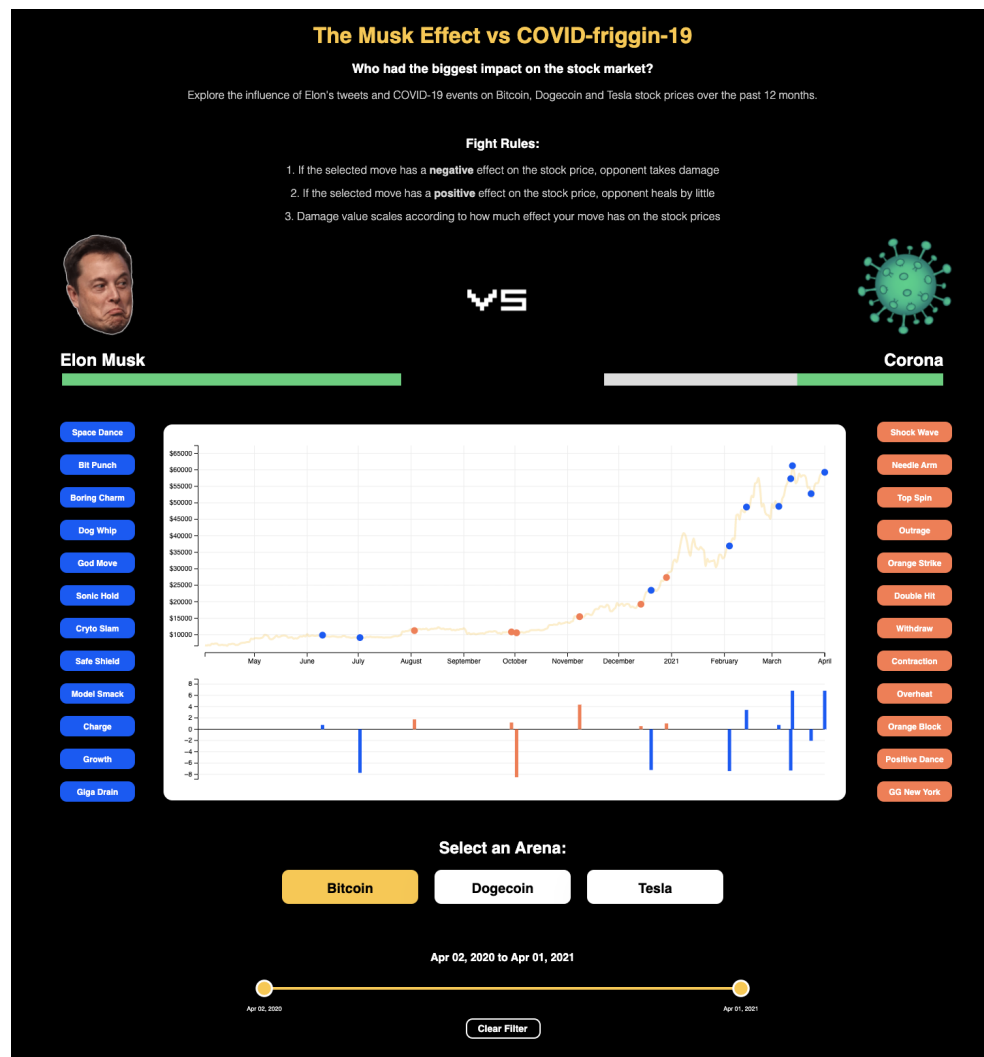
I. Data Description

The main stock datasets we used are obtained from Yahoo Finance - a media property that is part of the Yahoo network. It provides finance news, data, and commentary including stock quotes and financial reports. We downloaded three dataset Tesla, Dogecoin, and Bitcoin dated from 2020-04-02 to 2021-04-01 in csv format. The main attributes for the dataset are *Date*, *Open*, *High*, *Low* and *Close* prices - all calculated in US dollars. There are a total of 366 rows for each dataset, and we also observed some null values. We decided to use data smoothing to remove the null values to prepare our dataset for our line chart implementation. There are a total of 6 rows (dates) containing null values for dogecoin and 4 null values for bitcoin. We first looped over all the datasets and restored the price for the previous date, since we assume there should be no dramatic change to the stock price on the previous date. This allowed us to smooth out bad, null data entries by duplicating the data for the previous date. We also recorded the mother root for fake prices for future references. Next, we did some data augmentation by calculating the mean price before & after 5 (21) days, and the increase/decrease rate before & after 5 (21) days, adding extra columns in our datasets. (Note that there is no trading activity during the weekends for NASDAQ for Tesla stocks). Next, we rescaled our datasets, especially prices into .2f scientific numbers, and time parsed the dates into our desired format. For the Tweets dataset, we manually curated tweets from Elon Musk's official Twitter account. For the COVID-19 dataset, we manually selected major COVID-19 events from NBC News in a similar fashion. For each dataset, we collected 12 key dates detailing the corresponding events that occurred that day. Both dates and activities were chosen by the team after balancing case significance to the stock markets. Afterwhich, we gave each case a unique name reference so that we can easily represent them as buttons in our interactive visualization concept.

For our visualization, we wanted to investigate and explore the question of how Elon Musk and COVID-19 have impacted the stock market/elec-currency for given events across the past year. We acknowledge that the multi-factored nature of stocks is complex and this was also observed when we explored the stock csv files at face value. This inspired us to dig deeper into specific dates to see whether there were explicit, discoverable trends and observe if they had any significant change in stock market/elec-currency rate. Beyond that, we thought it would be interesting to design an engaging way that allowed our users to explore these same questions with us by delivering an interactive design in the form of a game.

Finally, we chose to use the *Close price* to measure the floating rate, simply because it is the final price at which stocks trade during regular market hours on a given day, which also provides an accurate measurement of the starting price of the next trading day. The rate for increase/decrease was derived and calculated with the *Close price* for the same reason.

II. Design Rationale



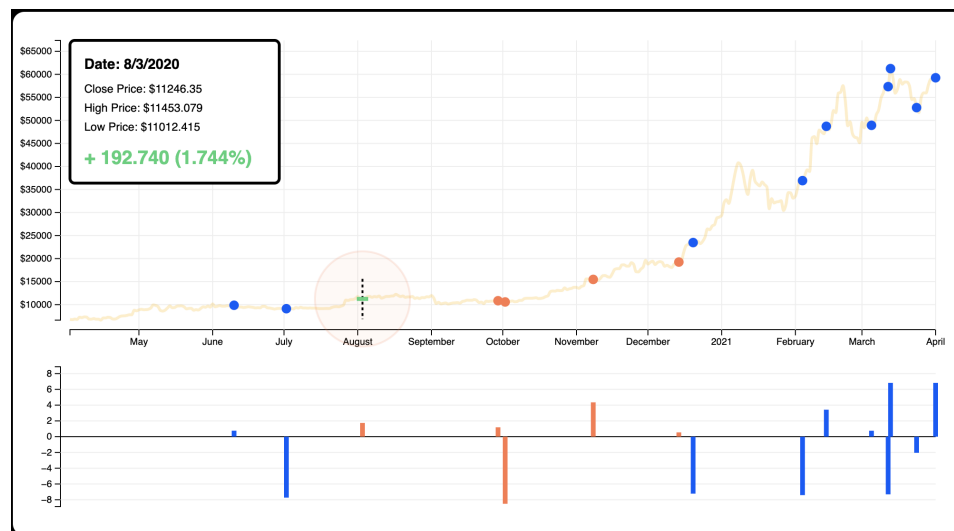
Our design approach was to create a fun and engaging way for our users to explore how key events can influence stock prices.

For our stock price data, we used a line chart with stock closing price as the y-axis and time as the x-axis. A linear scale was chosen for the y-axis as all three stock datasets had a relatively even price distribution. The marks are the lines, and channels are aligned vertical and horizontal position. We chose this approach as it is the most familiar representation of stock prices and we wanted our users to intuitively understand what our data represents from the get go.

The three stock datasets that we chose - Bitcoin, Dogecoin, and Tesla - were mapped to toggle buttons, which are presented to the user as 'Fighting Arenas'. Displaying only one stock dataset at a time was an intentional design decision as displaying multiple stock lines on the same graph clutters up the visualization and the different stock price scales are confusing when presented all at once.

For our Musk tweets and COVID-19 event dataset, we chose to visualize the data points as 'Fighting Moves' via buttons on the left and right of our line chart. The marks are the rectangular buttons and channels are color hue (Elon in blue and Corona in orange). Our tweet and COVID-19 event dataset is layered onto our visualisation in real-time as the user plays the game. When a move is selected, we use a candle plot to represent the point of 'attack'. The candle plot details the opening and closing price, as well as the price range of the stock on a particular date. For the candle color, we used green to represent a positive price change and red to represent a negative. We decided on this color pairing as it leverages our human intuition that associates red as bad and green as good. To help deuteranopia color-blind persons, we included text labels on the price details at the top left corner of our line chart.

After each move, we present the history of the user's fighting moves using a scatterplot which overlays the stock line chart to indicate where a move has been previously made. Together with the scatterplot, we incorporated a histogram to detail the significance/impact of the moves. The marks are the circles on the main chart area and rectangles on the histogram plot. The shared channels for both are color hue and an aligned horizontal position. The channel for the scatterplot is aligned vertical position and the channel for the histogram plot is aligned vertical length.

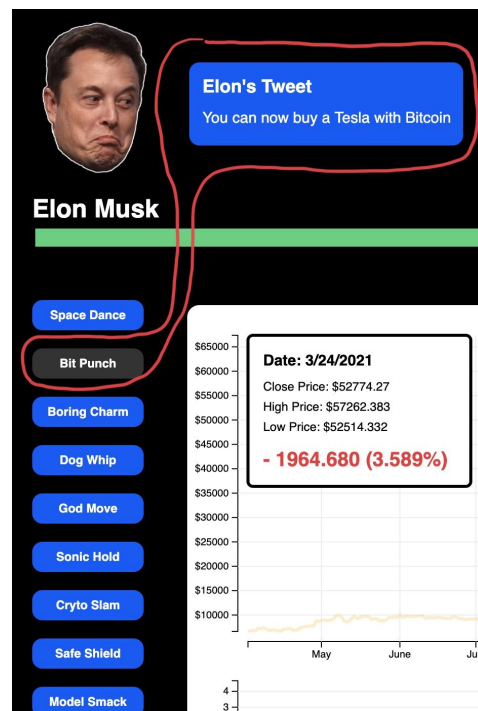


The design decision here was to provide a clear and engaging way for users to track their results to make meaningful conclusions on how their data plays out. By overlaying the scatterplot on the stock line chart, we convey to the user the frequency of these major stock-moving events, and the varied length of the points in the histogram allows us to accurately compare the significance of each move. We chose to use varied length to indicate significance of each move (as opposed to using area of the scatter points for example) as it is more precise in representing small changes in between each move.

Another fun design decision was to help out users conclude whether Elon Musk or COVID-19 had a greater negative impact on the stock market by aggregating the outcomes of their chosen 'moves' and visualizing that data as a health bar. The mark here are the health bar rectangles and the channels are color hue, and unaligned horizontal length. The color of the health bar changes from green to orange and then red as the health decreases. We designed this to help users tell which character has less health more easily, without which it would be challenging to distinguish narrow differences since the health bar decreases in opposite directions.

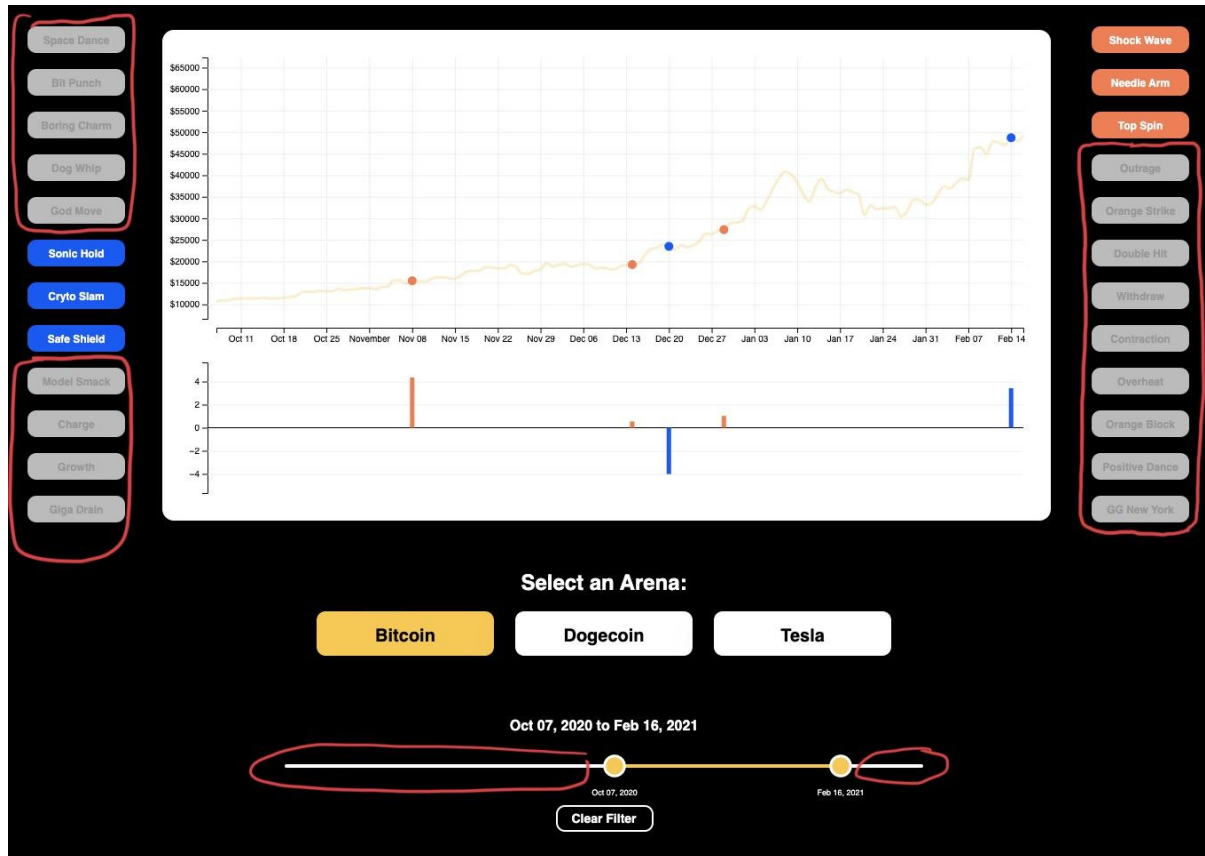
III. Interactive Rationale

A key element to the explorational design of our visualization was fully integrating all of our key components into one single experience for the user. At the foundational level, each move button dynamically maps points on our scatterplot during the game. We present the details of the move (tweet or COVID-19 event) next to the relevant character icon and use a typewriter-like animation to draw the user's attention to the event. Additionally, the 'fill' styling of the last selected move button is greyed out to give an illusion that the button has been activated and 'floats' right next to the character. This provides better context for users on the move that was selected and the character that is associated with it.



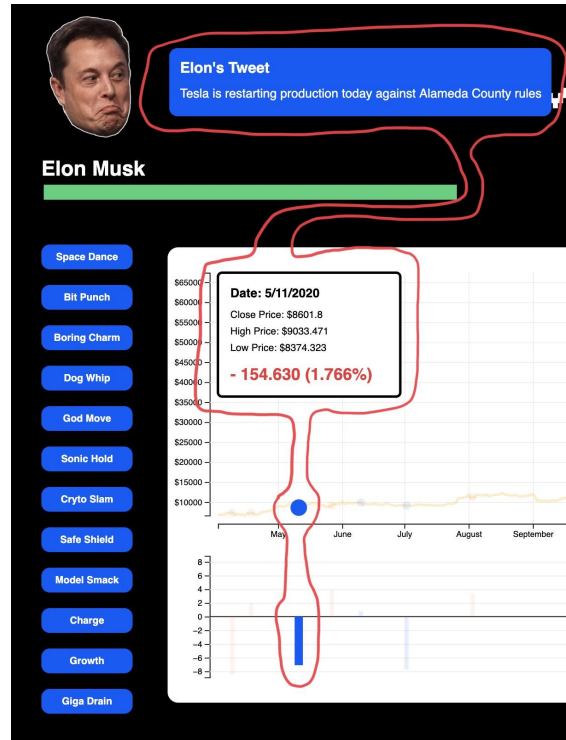
Next, we incorporated a time slider to allow the user to scope in on certain regions of the stock as they explore the visualization. This time slider not only scales the axis and gridlines dynamically, but it also ensures that move buttons that fall outside of the new range are disabled. This is to prevent users from making a move outside of the boundaries of the new

area of the plot, which can lead to confusion based on the lack of visible feedback. Additionally, when the time slider is adjusted, the histogram chart data is dynamically scaled to best fit the data points within the range. The user can simply reset the scale by clicking on the 'Clear Filter' button.

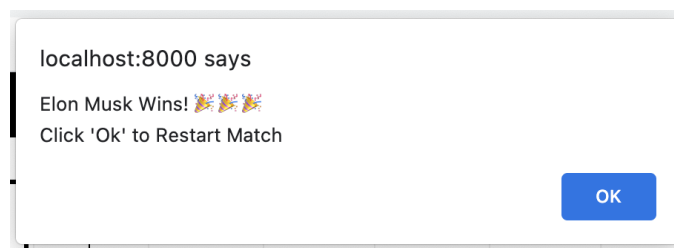


Clicking on the different arena buttons toggles the visualized stock dataset on our main chart area. The past moves and chosen time slider scale are recorded and that information can be revisited should the user switch back to their previous arenas as they interact with the visualization.

Next, we incorporated mouseover interactions to provide stock price information for the user at any given point on the line chart. Additionally, if the user hovers over an element on the histogram or scatterplot, our visualization provides the full details of the "hovered" move for the user to study their past actions as they progress with the game.



Finally, when one of the character's health goes to zero, the game ends and a window alert prompts the user with the results and an option to restart the match.



IV. Story

The coronavirus pandemic caused millions of people to lose their jobs and caused the biggest decline in the stock market since the great depression. However, in the past years, there was a big bounce for cryptocurrencies like bitcoin, about 10 times jump from \$6793 to \$58519. News Media portrayed Elon Musk's tweets as a critical factor that shot these cryptocurrencies record high. Others argue that the loose monetary policy of the world's central banks has brought high inflation expectations to the market, leading to the rise of bitcoin prices. From our visualization, we intuitively explore the rise and fall of bitcoin, dogecoin & Tesla stock prices followed by Elon musk's tweets. We found out the market price is almost independent of Musk's tweets we

selected randomly from his tweets record. While it seems like some of the events can trigger the fluctuation of cryptocurrency price, these triggers manifest themselves differently for bitcoin and dogecoin. Musk's effect on bitcoin leads us to believe that it has a longer-term effect. For example, when Tesla said it has bought \$1.5 billion worth of bitcoin and will accept the cryptocurrency for payment of its products, the price of bitcoin dropped 3 percent on that day but rose 6 percent in the following week. However, Musk's tweets about dogecoin results in a more immediate, short-term effect. When Elon said "why are you so dogmatic", this tweet boosted the price of dogecoin 12 percent on that day. Another good example is when Elon tweeted "Dogecoin is people's crypto", there was an immediate 43 percent increase in dogecoin price. But we also have to consider the base price range, because a minor change in bitcoin is much greater than dogecoin.

What we can interpret from the previous round of the bitcoin bull market is that, since the total amount of bitcoin is fixed, which is regarded as "digital gold" by some institutional investors and large companies, people believe that investing in bitcoin can hedge the demand for inflation.

However, we want to urge the investors to be careful with the cryptocurrency bubbles. On the morning of April 18, bitcoin collapsed, plunging nearly \$8000 in an hour. The high record of cryptocurrency price is nothing but a bubble that will burst sooner or later. Since the COVID-19 outbreak, the diversification of investment demand caused by risk aversion has become an important reason for the rise of cryptocurrencies like bitcoin, while the global easing policy has brought the momentum of their rise. Musk's investment in bitcoin can be seen as a way to diversify the allocation of his remaining liquidity and maximize returns.

At present, the market has different expectations on the future monetary policy of central banks, which makes cryptocurrency in a bull market of sharp rise and fall. Musk announced that participating in the bitcoin market will strengthen the status of bitcoin as a real asset. But we have to remind market watchers that cryptocurrency and other digital assets have always been considered as "long-term intangible assets" and have high holding risk. It is not wise to attune Musk's signals as those cryptocurrencies failed in their test as a safe harbor during the past year's stock market crash.

In the past years, the stock price of Tesla also had a huge jump from \$90 to \$667. The largest percent of increase (averaged in 5 days) happened in April 2020. Through the low interest rate environment following COVID-19, investors were having high expectations on the future expansion of the company. From our visualization, it seems like Musk has inspired a large number of loyal Tesla evangelists and investors, mainly through his frequent twitter feed and other ambitious speeches. Though there were some increases in Tesla stock price when Musk announced new generations of self-driving vehicles, we assume there are other factors that cause Tesla's growth and inspire investors' confidence other than Musk's tweets. After all, the company did really well in their advanced car business, and justified their prospective values.

Recent advances in vaccines have made economists more optimistic about the outlook for U.S. economic growth. Our original intention for adding COVID-19 events is to allow the user to

investigate deeper into how much key pandemic events and new coverage played a part in the volatility of our selected stocks datasets. Using our design allowed us to better recognize the impact of the bull market when the vaccine rolled out on Dec 14, 2020 for instance. We were able to observe that these positive effects continued in the following 10 days. From our exploration, we noticed a general pattern that COVID-19 pandemic events had long-term effects on the stock markets, but this was also challenging to measure due to the varied nature of each trend and its duration. Compared to the early pandemic days in spring 2020, society and enterprises are now significantly more adapted to the situation, and states and countries have taken targeted prevention and control measures instead of City closures and lockdowns. All of these are contributing factors, influenced by key COVID-19 events, that greatly reduced the adverse impact on economic recovery. Progress in vaccine production, distribution and vaccination is conducive to enhancing consumer confidence and supporting the slow recovery of restaurant, tourism, entertainment and other service industries. Overall, the stock performed remarkably well given the tragic circumstance of last year, but it would likely have performed even better if people could freely travel, spend money on products and services, and if Elon tweeted more.

V. Team Contribution

This project was executed in three phases: *Discover*, *Define* and *Develop*, *Report Writing*

Discover (2 Days)

We began the discovery phase by exploring different ideas for our interactive visualization and gave preliminary thought to how marks, channels and interaction mechanisms could be used for each idea. The distribution of work are as follows:

Tong: Explored the COVID-19 death count, Google word trends, and Elon Musk's tweets dataset and wrote ideas for how these could be used for an interactive visualization.

Zenas: Explored the car accidents, weather and Tompkins county COVID-19 cases dataset and wrote ideas for how these could be used for an interactive visualization.

Define (4 Days)

Our seed idea on the impact of Elon's tweets and COVID-19 events on the stock market was our favourite. We brainstormed design concepts and drafted them with simple wireframes on Google slides together:

<https://docs.google.com/presentation/d/1XEhTaBDOWx4iHxgTIBm3AQrca5xaUHiV9yg92LvcWi0/edit?usp=sharing>

Develop (12 Days)

Next, we distributed the programming workload evenly between the two of us as detailed below:

Tong: Curated the stock datasets and Elon Musk's tweets, cleaned the datasets and developed the move buttons, action texts and character health bars.

Zenas: Curated the COVID-19 dataset and developed the line chart, scatterplot, histogram, as well as the time slider and arena toggle buttons.

Report Writing (4 Days)

Finally, our report write up was distributed as such:

Tong: Wrote the data description and story sections of this report.

Zenas: Wrote the design and interaction rationale, and team contribution sections of this report.