Stock Machine

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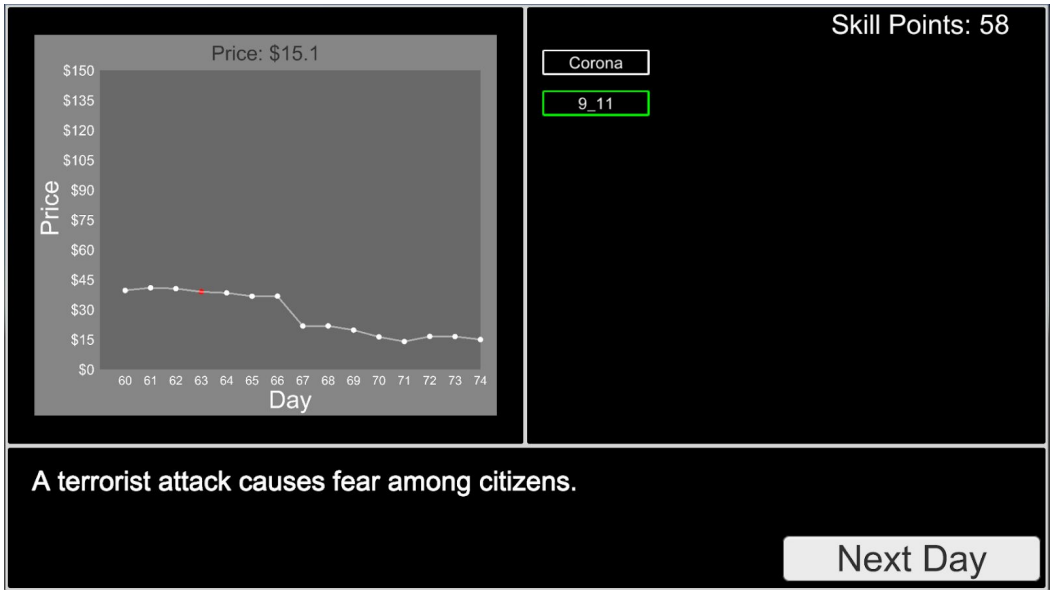

Fig. 1. An in game screenshot of Stock Machine. The top left window shows the current stock market. It incorporates a graph of the price over time along with the current price value over time. The top right window has the current events the user can unlock to impact the market. The bottom window describes the markets current state (ie. normal, or an event with a description of the event).

1. Introduction

One of the most essential tasks if you want to be successful when it comes to your money is properly investing it. A significant part of investing money comes from investing into the stock market. Despite this being such a large and important factor, many people are scared and don't know where to start when it comes to the stock market. As Warren Buffet said, "Wall Street is the only place that people ride to in a Rolls Royce to get advice from those who take the subway." It takes years of experience to understand the in and out of the stock market which can be intimidating to some. However, even the best stock brokers started with no knowledge whatsoever at some point. Stock Machine serves to introduce that stepping stone for people to get started. Stock Machine is an interactive visualization game based off of the American Stock Market that allows players to see how certain events can impact the market. These events can vary from something that's happening solely in the United States such as an election to something as large as a Global Pandemic like we are currently experiencing COVID-19.

2. Motivation

We created Stock Machine in hopes of being able to both encourage and provide people with a resource to start learning about the stock market. With hopes of providing a fun and interactive way to teach people about the stock market we needed to do something different besides a book or article on basic investing. As both of us are game design majors, we figured what better way to create a unique visualization of the stock market than to gamify the stock market. Thus, we came up with Stock Machine.

Our main target audience is those with minimal to no experience when it comes to the stock market. Stock Machine require no prior knowledge of the workings of the stock market which makes it a great stepping stone for those wanting to learn. It can also be used by professionals on Wall Street. Whether they would want to be able to see how a certain event would impact the market or visualize it to a potential client. Stock Machine was designed with the user in mind. It allows for an unlimited number of events or actions to be created simply by adding a csv file with the data and describing it in a text file for the program to read in. Thus, once a user has the basic understanding from the events we built in, they can continue to explore and create their own action and continuously learn how these actions can impact the market.

When creating this game, we had one question in mind; Does this game make it easier to understand the complex effects of real world events on the stock market.
H1: Breaking down these events and gamifying them should help users understand their impact. Due to physically seeing the data and how it changes over

Fig 2. A screenshot from Wall Street Survivor showing the core mechanics of the game. One builds up a portfolio of stocks (left side) and can view the growth or decline of their investments (right side)

time, the user would have a greater understanding of the impact.

H2: The impact of these events will not be fully realized as the game obscures the actual data points. Due to the fact that our visualization only shows a fraction of the event on top of partially synthetic data, the full impact of the event will not be realized. Thus a visualization of one single event would carry more weight then events in the game.

3. Related Work

Many people in the past have tried and successfully created games about the stock market. Many of their games are based on data from the current, present day stock market. You are given fake money to invest in stocks and see how your portfolio gains or shrinks over time. Two of those are the Stock Market Game and Wall Street Survivor.

The Stock Market Game is a simple simulation of the stock market, created as a teaching tool. This game is managed by the SIFMA Foundation, an organization created to teach young adults and children about finance. In this game players simply buy and sell real stocks, but with fake money. You either make money or you lose money. Typically a game like this requires supplemental teaching, and focuses more on simulating the current stock market.

Wall Street Survivor is a game made by Stock-Trak whose founder had a similar goal as us. He was disappointed in the lack of real world trading experience in his college class and thus created Wall Street Survivor designed specifically for college investment classes. You are given $100,000 in virtual currency and allowed to start creating your own virtual portfolio. It also introduces a competition aspect in which you can compete against other real people to see who can trade their way to the top.

Both of these games are great for allowing people to practice trading and investing in the stock market before risking real money. However, both of them are based off of current, present day data. We want to use data from past events that have happened to show people how these events impacted the stock market throughout its duration. Just about everybody is aware that certain events such as an election or pandemic or terrorist attack can severely impact the market. But very few people know or remember how much it impacted the market. Thus, the niche for our game was built.

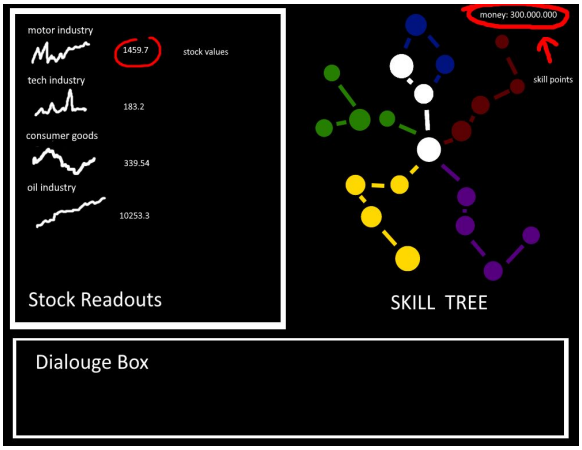

Fig. 3. Prototype of our initial UI with four different stock sectors in the top left and a full skill tree on the top left.

4. Design Process

4.1 Prototyping

Our initial idea was that as the player, your goal was to crash the stock market as a whole. Similar to the game Plague Inc. we wanted to incorporate some sort of skill tree that allowed for you to increase your sabotage skills. Ultimately, when every skill was unlocked in its full potential, you could completely crash the market. However, you had to gain skill points earned from causing small crashes using the beginner skills to fully unlock each skill.

We also wanted to split the stock market up into 4 different sectors. Our initial split was going to be the technology sector, oil sector, consumer goods sector, and transportation sector. We felt that this was a fairly good split of what makes up the stock market as a whole and would allow us to create enough events to specifically target each sector.

4.2 Data Collection

The next step in creating our simulation was to gather all the data. We started by developing a list of actions or events that have impacted the market. After determining what actions we wanted for our base, we had to figure out how to get the data. Through Yahoo Finance, we were able to select a start and end date to get the specific stock data from that time period. We were then able to download it as a csv file. As we were only interested in the stock symbol, date and closing value, using a simple python script, the that information was extracted and put into a new csv file eliminating the other data we didn't need.

The second purpose of this script was to take multiple csv files and combine them into one data set. Thus allowing us to create the four sectors we had planned on. We chose three stocks from each sector, all within the same time span and averaged the

values to create one value for that specific date.

The csv files were then put into a data folder. A c# script was written to locate this data folder, parse the files, and load the necessary data into lists. Specific event data were loaded into lists contained within action objects, while standard Nasdaq values were just contained as a public variable. The data for specific actions were stored in subfolders, within the main data folder. In a text document, specifications for the folder name, action ID, description, and other important aspects were stored. The action loader used this document to load specific data into the proper objects. Now, with the data loaded into a c# list object, it was possible to use Unity to create the visualization.

4.3 Final Visualization

After we had a prototype developed and all of our data collected, it was time to actually create our game. We realized that the window to display the graphs was too small to display 4 graphs and have axis labels and data points. We could have possibly done it without labels however we felt that it would have taken away from the overall impression that event would have on the market. Thus we opted to show one overall graph and not have any sectors. To ensure the data was easily readable and not crunched, we limited the number of days the user could see at one time to be 15 days.

The next step was to create the general trend line. As an event was going to be happening every day, we needed a standard set of data to base the trendline off of. We chose data from the NASDAQ over a 150 day period to use. We chose an initial starting value of $50 for our trendline and update it based on the percent change that the NASDAQ occured each day. This however didn't create very substantial changes which was what we were after. We chose to multiply the percent change by a random value in the rain of 2.75 to 3.75 to make the changes significant but also add some random noise to the data. This also ensures that no two runs of the game will be exactly the same.

After we ensured the data was properly displaying how we wanted too, we started implementing the actions. Once again, we used a random value to determine the likelihood of an event happening. Once the simulation determines that an event has happened, it randomly selects an event from the list of actions. Each action however has a certain weight to increase realisticness. Using the same method of percent change for the general trendline, a percent change is calculated for the event and applied to the trendline.

To increase the amount of actions within the selection pool, players can unlock new action. This is done by spending skill points, which are generated randomly over time. The original concept was to make a tree of unlockable actions. This would require a user to unlock actions in a certain order to obtain more significant actions. We ended up not implementing this step, since designing a realistic action tree would have taken too much time. Instead, we opted to allow players to choose any event, at any

time, given that they had enough skill points.

5. Peer Feedback

One of the main comments we received from our peers was relating to the event mechanism. People generally had mixed feelings in terms of a) the terminology used and b) having to gain enough skill points to enable an action.

In regards to the first point, many people pointed about the terminology of "Unlocking 9/11" or "Unlocking Coronavirus". This is a completely valid issue especially for those who know people specifically impacted by these events. Although we agree the terminology could be improved, it may have also been hurt by not having a full skill tree as we initially planned on. Similarly with Plague Inc. we don't think people are necessarily upset that you "unlock stroke" as there are other symptoms you unlock before that to build up to stroke.

In terms of having to gain points to unlock a negative action, this is the essential goal of our simulation. As it may not be positive, we are trying to show people how certain events, which typically have negative consequences, impact the stock market. Once again, a fully implemented skill tree would have most likely helped get this point across.

The other main comment we received was in regards to the overall trendline. As stated earlier, to avoid cramming the graph, we chose to limit it to be able to only view 15 days at a time. However, when the game reaches the end, people felt it would be nice to be able to view the full trendline and where events started and ended. This would allow for a better understanding of how the events impacted the market overtime and how back to back events can cause a downward spiral in the stock market.

6. Future Work

To continue this project, we would like to add many more actions to the game. The game is designed to handle around 30 actions with no changes to the UI, but past that, we may need to scale down the button size. Having hundreds of actions could still be possible with just a simple scroll wheel, so it is not out of the question. Being able to easily or dynamically create skill trees, is another action element we would like to add.

Designing a new way to display the data could allow us to display 4 or 5 graphs at once. If we had multiple graphs, a stock trading element could be added. This would have players investing their skill points in a stock to increase the rate that they are gained.

AI is another topic we discussed, but never got to implement. It would be interesting to have an AI play the role of the government, and take action against the player. The AI could attempt to unlock its own actions, countering the players actions. This would make gameplay more dynamic, since players would have to actually think about which actions they are buying.

7. Potential User Study

A user study could be conducted to show design flaws, as well as to test the effectiveness of this visualization. We hypothesize that:

H1: "Users that play this game will have a better memory of historical economic events, than users who see the effects on a static paper graph."

H2: "Users will have decreased accuracy when evaluating these economic events."

To test these hypotheses, we would pay around 20 college students to play our game. Users will first be presented with a questionnaire about their background and familiarity with the subject. Next users will be briefly explained how to play the game, and will begin playing. During the play session, users are encouraged to explain what they are thinking or seeing, to see how users are interpreting the game. After the play session users would be given a set of economic graphs, and we will briefly explain how to read these graphs. Users will still be encouraged to explain what they are thinking here.

Once both active sessions are concluded, users will be interviewed. The interview will consist of a series of questions about both the game and the graphs. Some questions may be open ended, while others may be scored based on correctness and level of detail. In a few days an online set of questions will be mailed to the user. These will also be scored.

From this data we can make a simple bar graph, which will show the scores of each user. We can compare the game scores to the economic scores, as well as comparing the short term to the long term scores. We can also compare the scores for each individual question. From the questionnaire in the beginning of the study, we can decide if there are outliers.

8. Contributions

The work was essentially split between backend and front end work. We both worked on creating the list of events we wanted to use. Eric focused mainly on the backend. He collected the data and used the python script to scrape away some of the garbage data we didn't need. Once the data was in Unity, he dealt with displaying it on the graph and incorporating the data from events into the graph. Jon focused on the action class, the internal data storage, and the canvas setup. He built the scripts to load all the event data into its proper locations. With the data stored properly, he then created an action class to allow a number of new actions to be seamlessly added to the game. This meant creating a dynamic button generator for selecting new actions, as well as careful consideration of the implementation of the action class. From there, he created an algorithm to randomly select weighted actions from a list.

9. References

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