CP2106: Independent Software Development Project

Orbital Final Report

of

Idle Trading Hero

from

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by

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Project Title: Idle Trading Hero - Automated Trading Platform

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Project Mentor: Yi Suqin

Proposed Level of Achievement: Artemis

Abstract

Idle Trading Hero is a trading platform to jumpstart automated trading strategies, coupled with an analytics dashboard for profit visualisation. Idle Trading Hero offers a suite of strategies that traders can employ to perform live algorithmic trading on the chosen market, with control over algorithm parameters. Existing platforms either lack profitable algorithms, lack accessibility due to difficult to understand algorithms, or lack control of algorithms in terms of parameter configuration. Idle Trading Hero therefore emerges amid this 3-way dilemma, to the best of our knowledge, faced by all existing trading platforms.

Subject Descriptors

Cloud Computing

RESTful web services

Client-server architectures

Multithreading

Keywords

Quantitative Trading, Technical Analysis, Web Development, Data Visualisation

Software

Microsoft Azure, Docker, Vue.js, Buefy, gRPC, SQLBoiler, Go, Python

Acknowledgement

We would like to express our deepest appreciation for our mentors, Chia De Xun, developer at a robo-advisor firm, and Stella Yi Suqin, assistant vice president at SgX. Their guidance, patience and continued support throughout our Orbital term enabled us to progress at a faster pace than we had imagined.

We would like to mention special thanks to Stella, our Orbital Mentor, for her patient understanding and guidance in polishing our solution to user demands, such as user experience. We would also like to thank De Xun, our Orbital Advisor, for his constant guidance as well as experience sharing that helped shape our solution to deliver our promises to address user needs.

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Introduction

Background of Trading Platforms

Trading platforms, e.g. MetaTrader/Quantopian, are established platforms that enable experienced traders to construct algorithms to perform algorithmic trading, a method of executing orders using automated pre-programmed trading instructions. However, all existing trading platforms, to the best of our knowledge, are not easy to use by beginner traders, lacking either profitability of algorithms, accessibility of algorithm details, and control of algorithm configurations.

Position of Idle Trading Hero

Idle Trading Hero is an automated trading platform targeted at beginner traders who find existing trading platforms too intimidating to learn. Idle Trading Hero provides a suite of established indicators known by the industry to be effectively profitable, and setting of parameters in order to customise and configure algorithm settings in order to personalise the algorithm according to the trader's preferences.

Background of Team

New Jun Jie (Jet) is a machine learning engineer intern at Grab working on probabilistic modelling for reinforcement learning, and previously at Infocomm Media Development Authority working on time series anomaly detection. With experience in modelling time series data, Jet works on the technical analysis indicators and strategies deployed in the server. Ian Soo Qi Xuan is a software engineer at Carousell working on the backend. With experience in web development, Ian works on the web dashboard and delivers insights using an aesthetic and clear interface.

Project Objective

Idle Trading Hero is a trading platform to jumpstart automated trading strategies, coupled with an analytics dashboard for profit visualisation. With an aim to deliver the 3 core principles of profitability, accessibility and control, the platform delivers a suite of established indicators recognised by the industry to be effectively profitable, and configuration of algorithms to customise to the trader's preferences.

Researched & Implemented Algorithms

The most established trading algorithms are the Moving Average Convergence Divergence, Relative Strength Index and Money Flow Index.

Moving Average Convergence Divergence

The Moving Average Convergence Divergence (MACD) is a trend-following momentum indicator that shows the relationship between two moving averages of prices. The MACD strategy consists of multiple indicators that use the exponential moving average (EMA). The EMA is computed by taking the exponentially-weighted average of the past $n$days of the instrument's price:

$$EMA_{Today} = (Value_{Today} \times \frac{Smoothing}{1+Days}) + (EMA_{Yesterday} \times (1 - \frac{Smoothing}{1+Days}))$$

The MACD line consists of the 12-day EMA subtracting the 24-day EMA. The Signal line is computed as the 9-day EMA of the MACD line. The MACD histogram is computed by the MACD line subtracted by the Signal line.

$$MACD_{Line} = EMA_{12-day} - EMA_{26-day}$$

$$Signal_{Line} = EMA_{9-day\ MACD}$$

$$MACD_{Histogram} = MACD_{Line} - Signal_{Line}$$

When the MACD histogram is positive ($MACD_{Histogram} > 0$), it means that the upside momentum is increasing, and when negative ($MACD_{Histogram} < 0$), downside momentum is increasing. When the MACD histogram crosses over from positive to negative, it triggers a sell action, and when negative to positive, it triggers a buy action.

Relative Strength Index

The Relative Strength Index (RSI) compares the magnitude of recent gains and losses over a specified time period to measure speed and change of price movements of a security to identify overbought or oversold conditions in the trading of an asset. The RSI ranges from 0 to 100, and computed as:

$$RSI = 100 - \left(\frac{100}{1+\frac{Previous\ Average\ Gain \times 13 + Current\ Gain}{Previous\ Average\ Loss \times 13 + Current\ Loss}}\right)$$

When RSI < 30, it indicates an oversold or undervalued condition. When RSI > 80, it indicates an overbought or overvalued condition, and may be primed for a reversal or pullback in price.

Money Flow Index

The Money Flow Index (MFI) is an oscillator that uses both price and volume to measure buying and selling pressure. The MFI is usually computed on a 14-day period as:

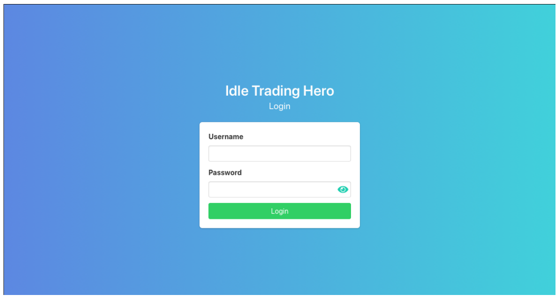
$$Typical\ Price = (High + Low + Close)/3$$

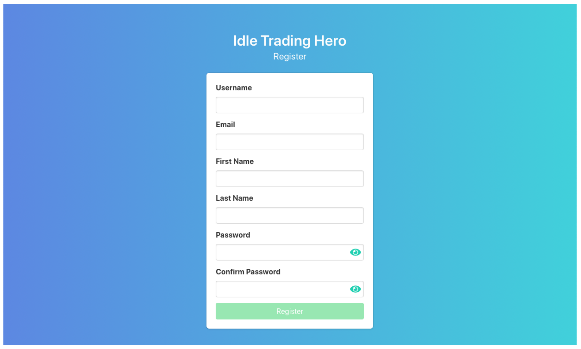
$$Raw\ Money\ Flow = Typical\ Price \times Volume$$

$$Money\ Flow\ Ratio = Money\ Flow_{14-period\ Positive} \,/\, Money\ Flow_{14-period\ Negative}$$

$$MFI = 100 - \frac{100}{1+Money\ Flow\ Ratio}$$

User Interface

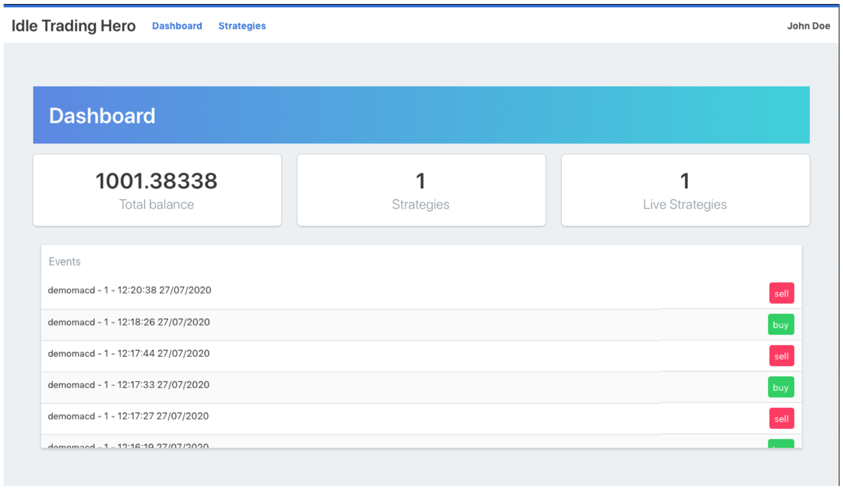




Authentication

Users are able to login by typing their credentials. The password field allows for viewing of cleartext so that users can check if their passwords were typed correctly.

Users are able to register for an account in Idle Trading Hero. The form performs basic validation such as email format and confirm password so that the user would be less likely to enter wrong credentials.



Dashboard

1001.38338 Total balance	1 Strategies	1 Live Strategies

Events

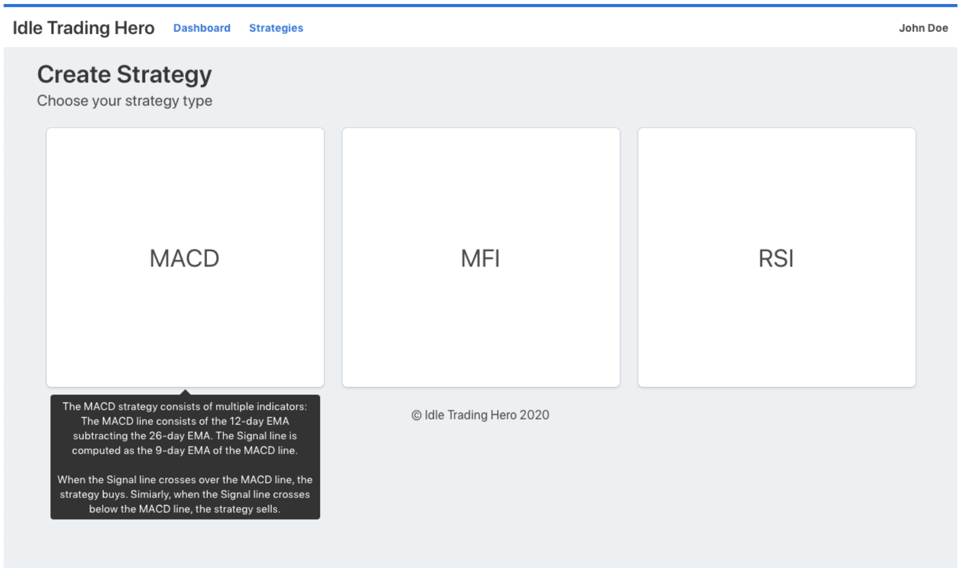
demomacd - 1 - 12:20:38 27/07/2020	sell
demomacd - 1 - 12:18:26 27/07/2020	buy
demomacd - 1 - 12:17:44 27/07/2020	sell
demomacd - 1 - 12:17:33 27/07/2020	buy
demomacd - 1 - 12:17:27 27/07/2020	sell
demomacd - 1 - 12:16:19 27/07/2020	

Dashboard

After logging in to the platform, users will see the dashboard. The dashboard shows the current situation of the account:

- Total Balance - The current amount of money in all strategies summed up
- Strategies - The number of strategies the user has
- Live Strategies - The number of actively trading strategies the user has

The events section provides a quick look for the user to see what recent actions the live strategies have taken. It also updates every 5 seconds so as to keep the user up to date on the strategy events that happen.



Create Strategy

Choose your strategy type

The MACD strategy consists of multiple indicators: The MACD line consists of the 12-day EMA subtracting the 26-day EMA. The Signal line is computed as the 9-day EMA of the MACD line.

When the Signal line crosses over the MACD line, the strategy buys. Simiarly, when the Signal line crosses below the MACD line, the strategy sells.

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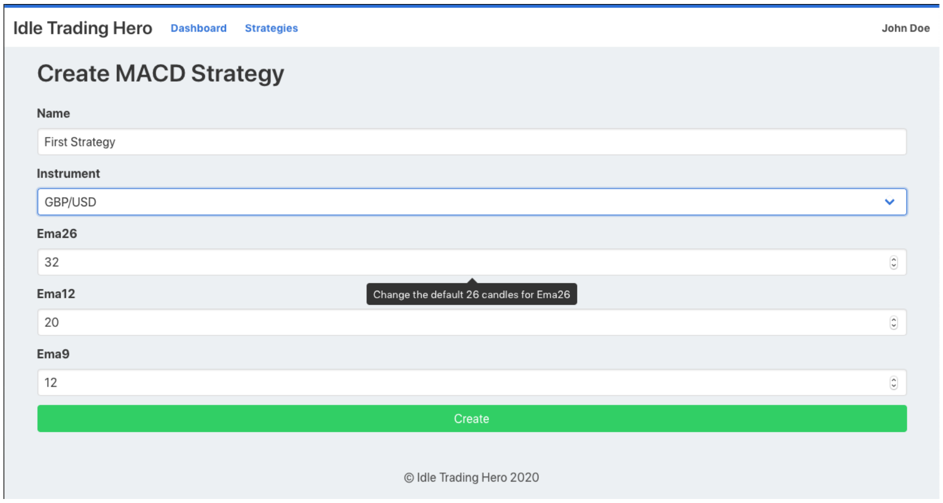

Create MACD Strategy

Name: First Strategy

Instrument: GBP/USD

Ema26: 32

Change the default 26 candles for Ema26

Ema12: 20

Ema9: 12

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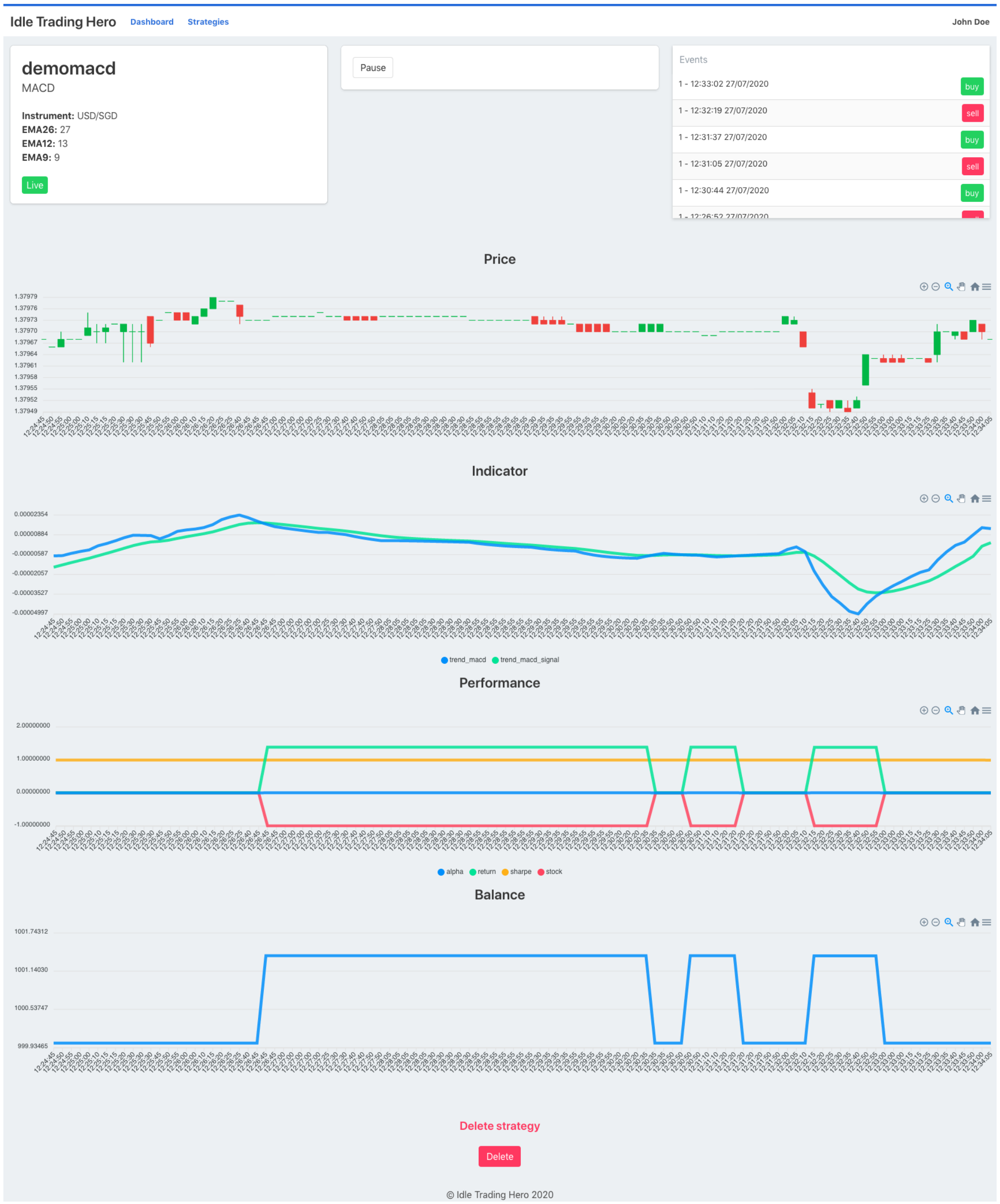
Create Strategy

Each option has a tooltip showing the details when the user hovers over.

Each strategy differs but the flow is similar: users fill up the name and instrument and the strategy's corresponding parameters. The 'Instrument' and strategy specific fields have tooltips to briefly let the user know what the field is for.



demomacd
MACD

Instrument: USD/SGD
EMA26: 27
EMA12: 13
EMA9: 9

Live

Events

1 - 12:33:02 27/07/2020 buy
1 - 12:32:19 27/07/2020 sell
1 - 12:31:37 27/07/2020 buy
1 - 12:31:05 27/07/2020 sell
1 - 12:30:44 27/07/2020 buy
1 - 12:26:52 27/07/2020

Delete strategy

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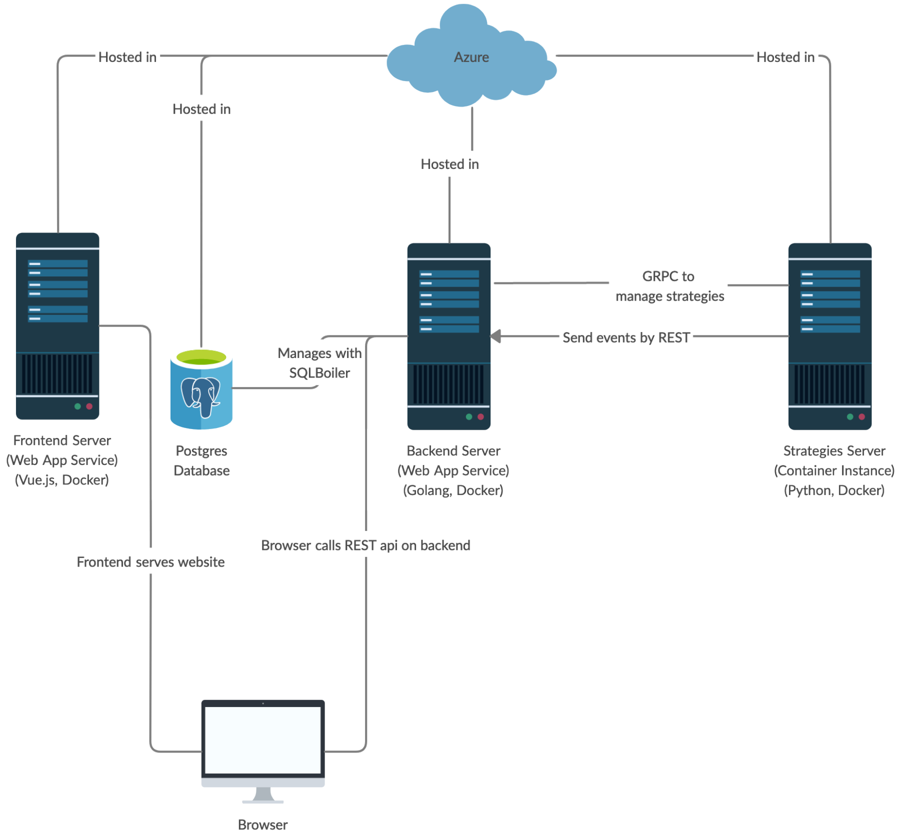
View Strategy Page

The Indicator chart shows the indicator's metrics. The Performance chart shows metrics that help the user understand if the strategy is performing well or not. The Balance chart shows the balance of the strategy over time. There is also an events section that shows events specifically for the current strategy. The user is also able to initialise, start, pause, and delete the strategy.

System Architecture



Azure
Hosted in
Hosted in
Hosted in
Hosted in
GRPC to manage strategies
Send events by REST
Manages with SQLBoiler
Frontend Server (Web App Service) (Vue.js, Docker)
Postgres Database
Backend Server (Web App Service) (Golang, Docker)
Strategies Server (Container Instance) (Python, Docker)
Browser calls REST api on backend
Frontend serves website
Browser

Idle Trading Hero consists of 4 interacting components: Frontend Server, Backend Server, Strategies Server and Postgres Database. The Frontend Server is developed using Vue.js and the Buefy framework. The Backend Server is developed in Go, and Strategies Server is developed in Python. The Postgres Database is used to store information about strategies.

Design Patterns

Model-View-Controller

The Model-View-Controller (MVC) is commonly used in web development where the responsibility of code is split between 3 layers: Model, View, Controller.

Model refers to the structure of the data and the logic associated with it. For example, a Student model could have a class with fields like: ID, Name, Age, Class, GPA. The class would act as a way to manipulate the data and there would also be associated functions that apply business logic to the model. In Idle Trading Hero, examples of models would be: User, MacdStrategy, MfiStrategy, RsiStrategy, StrategyEvent. These models are generated via SQLBoiler which also provides functions to query the corresponding tables in the database.

View normally refers to the presentation layer which visualises the data. In Idle Trading Hero, the backend server does not actually return a webpage when its endpoints are called, instead, JSON data is returned. This is because a frontend server that serves the web pages that would call the backend endpoints for data which would then be rendered by the frontend framework (Vue.js).

Controller refers to the layer that handles the actions requested (via a url endpoint). Controllers will interact with the model to manipulate the data according to the business logic before returning a view to the requester. In Idle Trading Hero, the controllers are: Auth, Strategy, StrategyEvent.

Repository Pattern

Repositories are a set of components that contains the logic required to access the data source. In Idle Trading Hero, the pattern is utilised so as to keep the database manipulation logic in a single layer so that other layers can use it without needing to deal with data access related logic. These repositories are: User, Strategy, StrategyEvent.

Server Interface

REST

Idle Trading Hero implemented a Representational State Transfer (REST) API so as to provide a means of interfacing with the backend server from the web pages. REST was chosen for the backend server due to its simplicity and our existing experience in creating and using RESTful APIs. The REST APIs would then allow the frontend to use libraries like Axios.js to create http requests to invoke actions on the backend server.

gRPC

gRPC is an open source remote procedure call (RPC) framework developed by Google for efficiently connecting services. gRPC utilises protocol buffers for serialising data which is more efficient than JSON in terms of size. gRPC was chosen as it provided a simple way of interfacing with the Strategies Server from the Backend Server. In addition, protocol buffers is helpful in reducing the bandwidth used when the Strategies Server has to provide time series data.

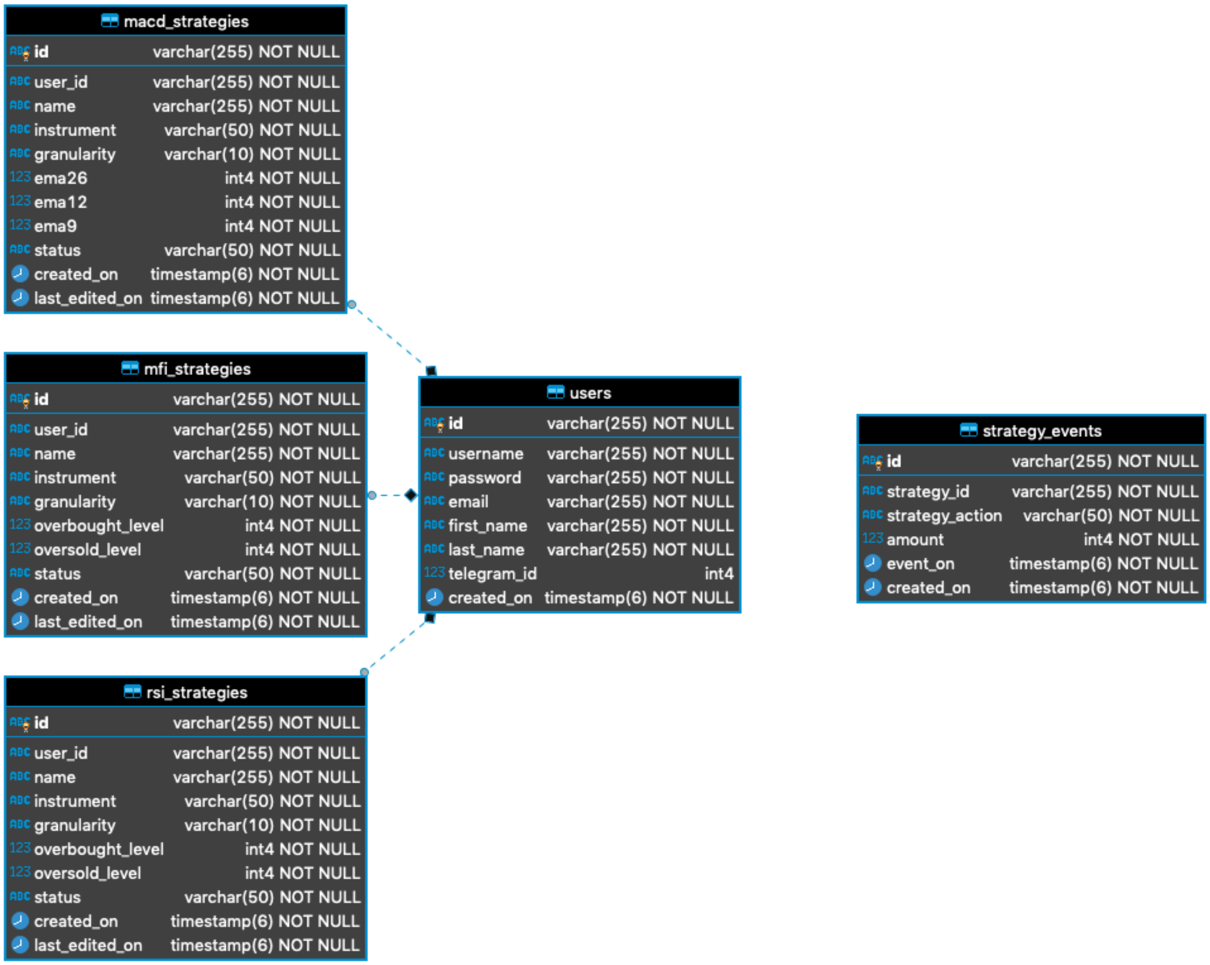
Docker

Docker enables developers to pack their apps inside a container. From Docker's website: "Containers are a standardized unit of software that allows developers to isolate their app from its environment, solving the 'it works on my machine' headache." In Idle Trading Hero, this allows us to effectively develop the program on separate computers as the environment is the same for both of us despite 1 of us using macOS and the other Windows. Furthermore, the containerised app also allows for easier deployment onto the cloud as we do not need to deal with framework specific deployments as the cloud service we are using, Azure, provides services that accept dockerized apps, allowing it to work almost immediately without little modifications.

Azure

Azure is a cloud platform that provides services to host VMs, Websites, database, and more. It was chosen due to us having free credits and prior experience using it. Currently, Azure manages our 3 servers (Frontend, Backend, Strategies), our Postgres database, container registry, and our domain.

Database



macd_strategies	
id	varchar(255) NOT NULL
user_id	varchar(255) NOT NULL
name	varchar(255) NOT NULL
instrument	varchar(50) NOT NULL
granularity	varchar(10) NOT NULL
ema26	int4 NOT NULL
ema12	int4 NOT NULL
ema9	int4 NOT NULL
status	varchar(50) NOT NULL
created_on	timestamp(6) NOT NULL
last_edited_on	timestamp(6) NOT NULL

mfi_strategies	
id	varchar(255) NOT NULL
user_id	varchar(255) NOT NULL
name	varchar(255) NOT NULL
instrument	varchar(50) NOT NULL
granularity	varchar(10) NOT NULL
overbought_level	int4 NOT NULL
oversold_level	int4 NOT NULL
status	varchar(50) NOT NULL
created_on	timestamp(6) NOT NULL
last_edited_on	timestamp(6) NOT NULL

users	
id	varchar(255) NOT NULL
username	varchar(255) NOT NULL
password	varchar(255) NOT NULL
email	varchar(255) NOT NULL
first_name	varchar(255) NOT NULL
last_name	varchar(255) NOT NULL
telegram_id	int4
created_on	timestamp(6) NOT NULL

strategy_events	
id	varchar(255) NOT NULL
strategy_id	varchar(255) NOT NULL
strategy_action	varchar(50) NOT NULL
amount	int4 NOT NULL
event_on	timestamp(6) NOT NULL
created_on	timestamp(6) NOT NULL

rsi_strategies	
id	varchar(255) NOT NULL
user_id	varchar(255) NOT NULL
name	varchar(255) NOT NULL
instrument	varchar(50) NOT NULL
granularity	varchar(10) NOT NULL
overbought_level	int4 NOT NULL
oversold_level	int4 NOT NULL
status	varchar(50) NOT NULL
created_on	timestamp(6) NOT NULL
last_edited_on	timestamp(6) NOT NULL

The database mainly contains the users information, strategies created, and events generated by the strategies. As explained previously, these tables would then be used to generate the models via SQLBoiler. SQLBoiler is an Object Relation Mapper that would allow for easier querying of the database entities.

User Validation

A necessary procedure of every project is the validation of the needs faced by the end-user, in our case, being traders. We conducted a series of interviews with real traders and friends, providing a beta access to the Idle Trading Hero platform. In particular, we engaged start-up founder Chua Bing Quan, software engineer Toh Bing Cheng, DIY investor Ng Wai Ching, and friends who are beginner traders, Ethan Heng and Tan Jun Jie.

Chua Bing Quan, Startup Founder

“Idle Trading Hero is a really suitable platform for me. As a side trader, it allows me to use algorithms that can profit, and at the same time with its easy-to-use interface, provides the ability for me to tune these algorithms to fit my needs, which helps me to achieve my goals of profiting and at the same time making the process easier.”

Toh Bing Cheng, Software Engineer

“I do some trading in my part time during my free time. When I use the platform Idle Trading Hero, the navigation seems to be very straightforward and intuitive, I get to go to what I need to see in a few clicks. And I can see they have included many of the most popular indicators out there like MACD, RSI and MFI. These would be very useful for beginners to start with as these are the most common indicators. When you start on algorithm trading, you can easily see what goes behind the scenes and why the algorithm makes a decision to buy or sell, which is very good for new traders to learn the process of how to trade. And this isn’t available in other platforms that I’ve tried, where it’s more of a ‘black box’ sort of thing, where you don’t know what the algorithm is doing to buy or sell. So I think this is a very good addition they have compared to other platforms.”

Ng Wai Ching, Consultant

“I feel that Idle Trading Hero is very useful for providing live forex trading and monitoring capabilities for the respective trading strategies. At the same time it is also useful and flexible in allowing me to customise different parameters for different types of trading strategies for my experimentation.”

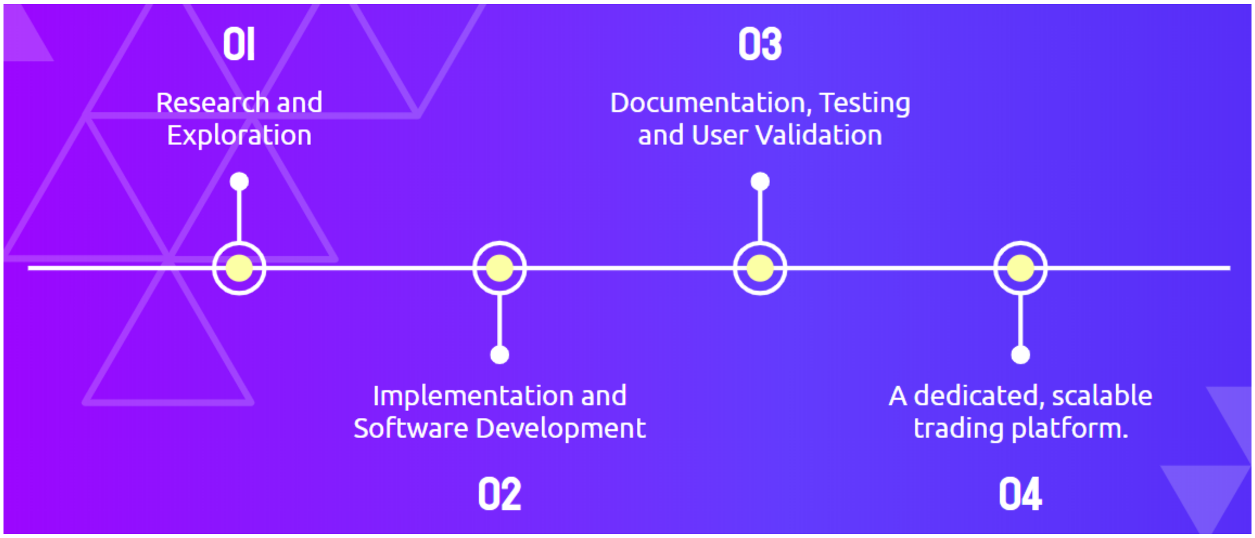
Ethan Heng, Beginner Trader

“As a beginner trader, I feel that one of the problems is that sometimes it can be very overwhelming, it (platforms) can have a lot of information. So having this web app was actually quite reassuring, ‘cos it kind of guided me like, quite straightforward, and at the same time there was a lot of flexibility in deciding what I could do and what I should do. It was hand-held but at the same time it was giving me a lot of areas to explore and find out for myself. I enjoyed it and it was easy to learn from.”

Tan Jun Jie, Beginner Trader

"For me, I'm a beginner trader in this trading industry. When I first started this journey, trading has a lot of jargon, technical terms and was very complicated and inaccessible to beginners. And even though there are many resources out there, it is very difficult for a complete beginner to pick up the skills they need or require. When I first started this journey, I tried platforms like MetaTrader and TradingView, and I think one pain point I had was that the platforms were not very accessible, the user experience was not that great for me, and I have to look up many terms and struggle a little. And that is when I started to switch to Idle Trading Hero, and what I realised is that it is much more accessible to beginners and beginner friendly. I think one of the main selling points of Idle Trading Hero is that I get to see what the algorithm is doing, so at least I have some control over what sort of processes are going on and it won't seem that much like a 'black box'. And these 3 points on profitability, accessibility and control are features that are very beneficial and are things that the Idle Trading Hero offers, and as a beginner I really enjoyed the experience using Idle Trading Hero and will definitely recommend anyone, any beginner in this market and industry. I hope the developers of this platform will roll it out to the public in the future so as to benefit more beginners and encourage this journey in the trading industry."

Timeline & Schedule


01
Research and Exploration
03
Documentation, Testing and User Validation
Implementation and Software Development
02
A dedicated, scalable trading platform.
04

Our journey in Orbital has been a long but extremely fruitful one. We summarise it in 4 phases. The first month is invested on research and exploration of the existing platforms in the market, to understand user needs and desires. We thoroughly study the field of technical analysis, indicators and extensions to automated trading such as fundamental analysis using sentiment analysis services and machine learning timeseries forecasting algorithms. In the second month, we focused on implementation of the technical algorithms as well as development of the software architecture for robustness in scalability. In the third month, we spent the time documenting the specifics of technical analysis algorithms and strategies, robustly tested both the algorithms as well as the software and server infrastructure, as well as engaged with real traders and friends to validate our platform's effectiveness in addressing their needs in passive trading. The fruits of our labour is now harvested into Idle Trading Hero, which we can proudly present as a dedicated, scalable trading platform.

Future Directions

Idle Trading Hero has successfully delivered the 3 promises of Profitability, Accessibility and Control. It has shown effective as a proof-of-concept what an automated trading platform can aim to achieve to cater towards beginner traders. Nonetheless, there is still room for improvement, specifically in the range of technical indicators that can be deployed and the legal clearance for the deployment of such a platform in production. Future work includes application of fundamental analysis methods as well as machine learning-based methods as signals for automated trading. In addition to technical improvements, user experience is also an area to be improved so that users can have a better experience on our platform.

Conclusion

Idle Trading Hero reflects on our 3 core principles of Profitability, Accessibility and Control, that we think trading platforms should embody. These are the 3 fundamental needs that our users want, and the majority of our beta platform reviewers agreed that the platform has delivered on their 3 core needs for passive trading, which we are proud of and glad to have achieved. In the 3 months of Orbital, we have acquired valuable knowledge of the trading ecosystem, and technical analysis fundamentals and extensions to automated trading. We have polished our software development skills in software infrastructure construction and server orchestration. We have gained valuable experience in user needs testing and scalability testing in our solution servers. These are achievements that we are proud of to have gained from this short span of 3 months.