Brainsteins

Helping innovate ADHD research through gamification

Origin of the creative idea

- ADHD affects approximately 5–7% of children worldwide, according to the American Psychiatric Association and WHO data.

- ADHD remains a complex disorder, and more research is needed to fully understand its causes, mechanisms, and the most effective treatments for different individuals.

- There is widespread hesitation among parents when it comes to seeking an ADHD diagnosis for their children, compounded by the high costs associated with the diagnostic process.

02

Our solution

We present to you, BRAINSTEINS:

- Gamification of ADHD diagnosis through minigames designed for children, presented via an easily accessible app available on all phones, for early detection of ADHD.

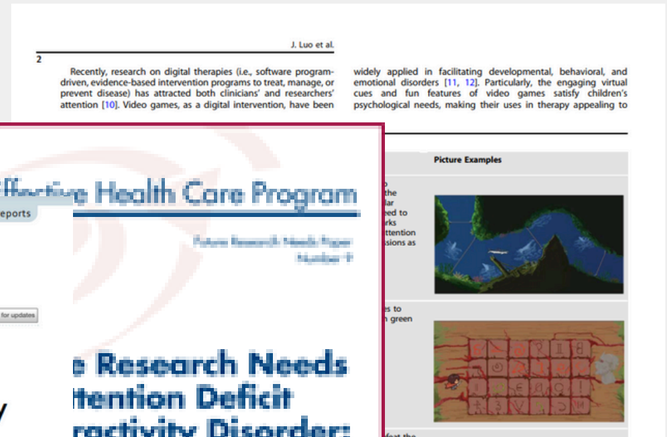
- User-friendly panel for monitoring the child's behavior during game sessions, that displays data useful for monitoring the possibility of ADHD, with a prediction score of how likely they have it.

- Leveraging AI techniques, to highlight the importance of data and its role in further understanding the ADHD condition, such as eye tracking via computer vision.

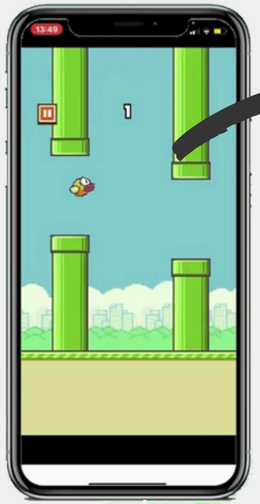
Evidence

- Studies boast about the gamification of ADHD diagnosis, and the use of video games to identify conditions of hyperactivity
- There are instances of eye tracking being used in ADHD diagnosis to analyze visual attention patterns, saccades, and fixation stability, providing objective insights into attentional control and impulsivity. (Expensive hardware)

Tobii Dynavox Eye tracker



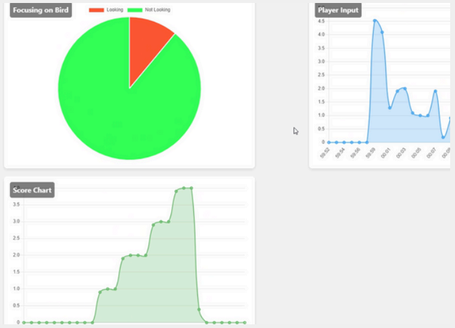
How brainsteins works:



Input Jitter

Gaze position

Computer vision model to analyze wether player is focusing or not



Displaying information for data analysis, as well as ADHD predictions

	value	timestamp	data_type
		Filter	Filter
3978	818181,267.691804748863…	2024-12-19T17:56:35.036568	bird_position
3979	818181,255.316804748863…	2024-12-19T17:56:35.197838	bird_position
3980	818181,248.761254471113…	2024-12-19T17:56:35.286278	bird_position
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3982	818181,247.566818915613…	2024-12-19T17:56:35.573196	bird_position
3983	818181,256.0389933601135	2024-12-19T17:56:35.705474	bird_position
3984	1.0	2024-12-19T17:56:35.988617	player_input
3985	818181,284.6640283601135	2024-12-19T17:56:35.989656	bird_position
3986	3.0	2024-12-19T17:56:35.988617	score
3987	818181,276.9418105823635	2024-12-19T17:56:36.345458	bird_position
3988	818181,260.497385026863…	2024-12-19T17:56:36.592295	bird_position
3989	818181,242.400143915863…	2024-12-19T17:56:36.820752	bird_position
3990	818181,239.983493915863…	2024-12-19T17:56:36.948932	bird_position
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3992	818181,241.983518915863…	2024-12-19T17:56:37.090104	bird_position

Building a rich dataset of data about ADHD, as well as accurate ADHD predictions

And this is all thanks to a mobile app!

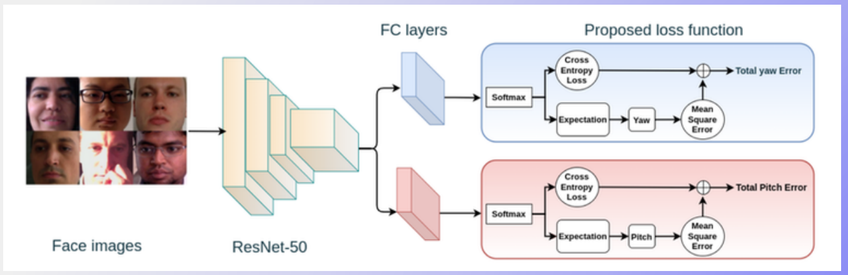
Our stack

- We are using Flutter for cross-platform efficiency and consistency, and thanks to its Flame library.
- We use Flask for its simplicity, flexibility, and lightweight design, making it ideal for building scalable applications minimal overhead.
- We use Roboflow's inference server, hosted on a Docker container, as well as their computer vision gaze estimation model.
- We use scikit-learn to train our model.
- We use sqlite3 as our database.

02

Our AI

- L2CS-Net model for gaze estimation (computer vision)
- We develop our RandomForestRegression model using a dataset
- We make a chatbot using all-MiniLM-L6-v2 sentence transformer model



02

- We tried both XGBoost and RandomForestRegressor models, both have comparable accuracy. (But accuracy is not the only factor)

- We use a RandomForestRegressor model (n_estimators = 100), because, because it is simple to implement, efficient to train, and provides clear feature importances. It performs well without the need for extensive hyperparameter tuning. Additionally, it allows for easy interpretation of feature significance, which is valuable in understanding ADHD-related metrics.

```
            Feature  Importance
1           std_dev    0.416554
0     average_score    0.353599
2  focus_percentage    0.229847

Root Mean Squared Error (RMSE): 0.8263340794392494
R-squared (R²): 0.9923516928612702
['adhd_model.pkl']
```

RandomForestRegressor

VS

```
            Feature  Importance
0     average_score    0.892818
1           std_dev    0.088978
2  focus_percentage    0.018204

Root Mean Squared Error (RMSE): 0.8694806072226734
R-squared (R²): 0.9912313022753262
['adhd_model.pkl']
```

XGBoost

Training our prediction model

02

Training our prediction model

- Our model spits back an ADHD-RS score. The ADHD-RS score is specifically designed to assess the severity of symptoms related to ADHD, making it highly relevant in the context of ADHD diagnosis and research.
- We feed our model 3 values, the standard deviation of input frequency (indicating impulsivity), focus percentage which is how much of the time the user is actually looking at the player character (indicating attention-deficit), and average score.
- Comparing feature importance demonstrates that the average score info is not important in ADHD diagnosis.

03

Business

Brainsteins enhances traditional diagnostic methods by combining gamification and AI, offering several benefits:

- Remote access and scalability reduce costs and improve access, especially in underserved areas.

- Collects data in a stress-free, real-world environment, enabling continuous monitoring of behavior and capturing subtle nuances, which means more data, which means more business.

- Nearly 2 million U.S. children with ADHD did not receive ADHD-specific treatment in 2022. About 9.4% of children in the U.S. have been diagnosed with ADHD. This is a large market that is left unconquered.

03

- Our model touches 2 clients, parents and doctors, both of which are eager for tools to cheaply help identify ADHD early for their children, and their clients.

- While there are a few digital tools emerging to assist in ADHD diagnosis and management, many of them are either limited in scope or prohibitively expensive.

	BRAINSTEINS		
Cost	Free	Expensive	Expensive
Hardware	No need	No need	Requires hardware

04

Future, and challenges

Our plans for the future:

- We plan to collaborate with doctors and institutions to gather valuable data for ADHD research.
- We aim to connect with researchers who are interested in using our platform to further ADHD studies.
- Our goal is to create more mini-games, collect other metrics and have our app scientifically validated and approved.

04

We will meet the following challenges

- We need to address overlapping symptoms with other conditions to avoid misdiagnosis.
- Ensuring data accuracy is crucial; we can't afford mistakes or outliers in our results.
- We are committed to safeguarding user privacy and maintaining strict confidentiality.

05

Conclusion

- Brainsteins aims to use AI and gamification to create an early ADHD detection model that is available for everyone

- Brainsteins to standardize ADHD diagnosis, creating metrics based on data, much more concrete than current standards (DSM-5)

Thank You