Identification of 3D Attention Points in Virtual Reality Scenes Final Presentation for Analysts

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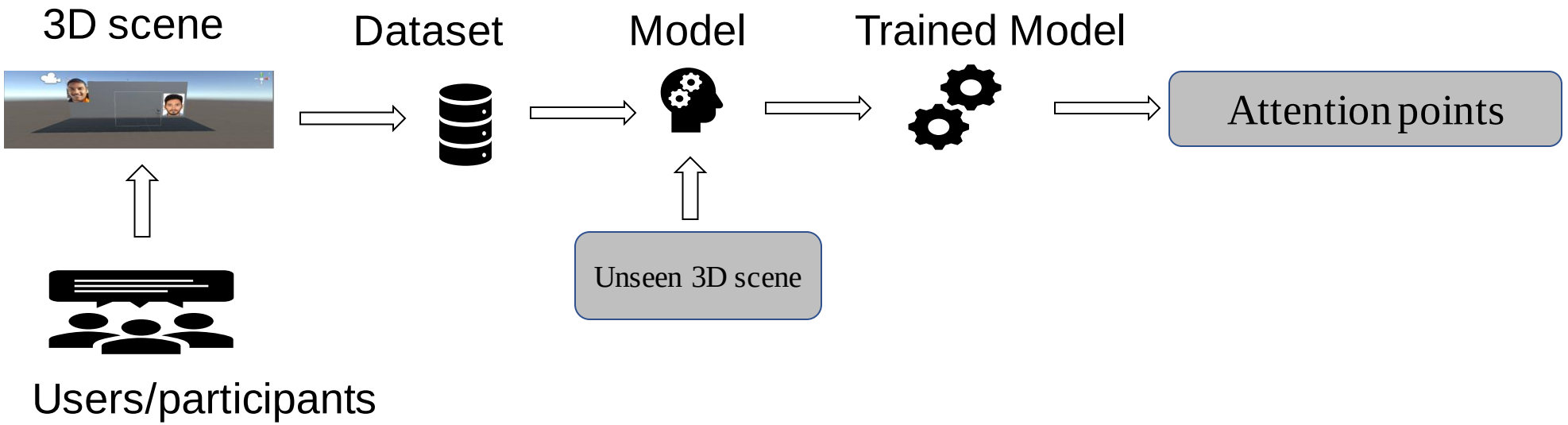
Presentation Outline

1. Introduction
2. Background Discussion
    a. Why this project?
    b. ABM and CBT
3. Data Preparation
4. Data Visualization
5. Model Planning
6. Model Building
7. Model Evaluation
8. Conclusion and Future work
9. References and Links

Introduction

First things First!!

What are we doing in this project?



Predicting 3D attention points in unseen scenes

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Background Discussion

Why this project??

Application areas

Our main focus is on health care (ABM and CBT) and Business (Marketing)

ABM and CBT

ABM (Attention Bias Modification)

- A treatment for anxiety disorders.
- Designed to shift attention away from threat.

CBT (Cognitive Behavioral Therapy)

- Cognitive Therapy
  - Focuses on identifying emotional responses, thinking patterns.
- Behavioral Therapy
  - Addresses behaviors and thinking patterns and incorporates strategies such as mindfulness and emotional regulation.
- Exposure Therapy is a type of CBT that can be implemented either by In vivo exposure, Imaginal exposure or Virtual Reality exposure.

Data Preparation

- Creation of virtual reality environment
    - Unity software
    - 2 images with different emotions
    - https://drive.google.com/open?id=1mRtVv3y0xmt7XdQ-eGYdc8--AU87t1sd
- Recording the data from the participants
    - Six participants
    - Tobii eye tracker
    - Features such as object position, object scale, gaze positions are recorded
- Structuring the data
        - Excel format
- 1000 instances are captured

- 3D scenes have x, y, z coordinates.
- Each position value is split into 3 different features.
- Altogether, there are 33 features in which 3 are target labels.

E.g. Object1position (x, y, z) -> object1position_x, object1position_y, object1position_z

	object1position_x	object1position_y	object1position_z	object1rotation_x	object1rotation_y	object1rotation_z	object1scaling_x	object1scaling_y	object1scaling_z	object2position_	object2position_y	object2position_z	object2rotation_x	object2rotation_y	object2rotation_	object2scaling_x	object2scaling_y	object2scaling_z	c
2	6	2.7	-0.2	0	0	0	150	150	150	-5.5	2.5	-0.4	0	0	0	150	150	150	
3	-9.2	1.8	-0.4	0	0	0	150	150	150	0	3.5	-0.2	0	0	0	150	150	150	
4	3.1	3.2	-0.2	0	0	0	150	150	150	7.4	2.7	-0.4	0	0	0	150	150	150	
5	-6.7	3	-0.3	0	0	0	150	150	150	-2.3	2	-0.4	0	0	0	150	150	150	
6	2	1.6	-0.2	0	0	0	150	150	150	-7.9	3.4	-0.4	0	0	0	150	150	150	
7	0.2	1.6	-0.5	0	0	0	150	150	150	4.7	1.9	-0.3	0	0	0	150	150	150	
8	-5.9	2.1	-0.2	0	0	0	150	150	150	2.2	3.2	-0.4	0	0	0	150	150	150	

	object2scaling_z	camerapc	camerapc	camerapc	cameraro	cameraro	cameraro	camerasc	camerasc	camerasc	wallposition_x	wallposit	wallposit	wallrotat	wallrotat	wallrotat	wallscali	wallscali	wallscali	planepos	planepos	planepos	planerota	planerota	planerota	planesca	pl	attentionposition_x	attentionposition_y	attentionposition_z
2	150	-4.5	5	-20	0	0	0	1	1	1	-2.54	2.77	0.24	-90	0	0	0	1	1	1	-2.51	-5.04	0	0	0	1	1	-8	3.6	-9.7
3	150	-4.5	5	-19.7	0	0	0	1	1	1	-2.54	2.77	0.24	-90	0	0	0	1	1	1	-2.51	-5.04	0	0	0	1	1	-4.5	1.8	-9.4
4	150	-4.5	5	-19.2	0	0	0	1	1	1	-2.54	2.77	0.24	-90	0	0	0	1	1	1	-2.51	-5.04	0	0	0	1	1	-2.7	2.6	-8.9
5	150	-4.5	5	-16.6	0	0	0	1	1	1	-2.54	2.77	0.24	-90	0	0	0	1	1	1	-2.51	-5.04	0	0	0	1	1	1	2.4	-6.3
6	150	-4.5	5	-14.4	0	0	0	1	1	1	-2.54	2.77	0.24	-90	0	0	0	1	1	1	-2.51	-5.04	0	0	0	1	1	-5.8	2.2	-4.1
7	150	-4.5	5	-17.7	0	0	0	1	1	1	-2.54	2.77	0.24	-90	0	0	0	1	1	1	-2.51	-5.04	0	0	0	1	1	-6.3	2.3	-7.4
8	150	-4.5	5	-14.2	0	0	0	1	1	1	-2.54	2.77	0.24	-90	0	0	0	1	1	1	-2.51	-5.04	0	0	0	1	1	-1.2	1.4	-3.9

Fig 1. Few samples from the dataset

Data Visualization

Scatter Plot

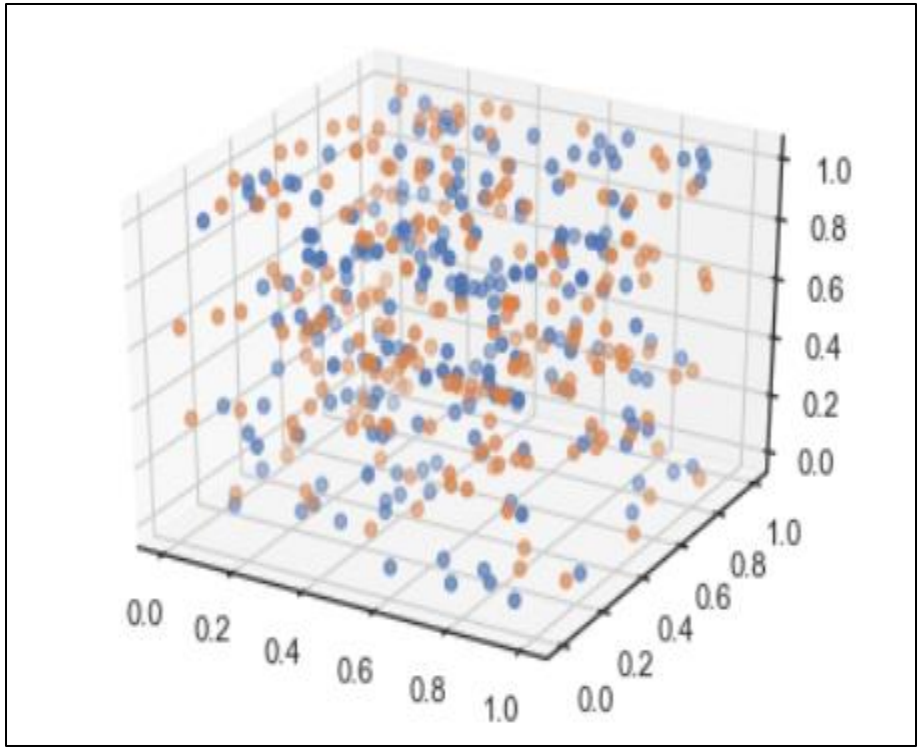

Fig.2 Normalized data of object 1 & 2 positions

Correlation Matrix

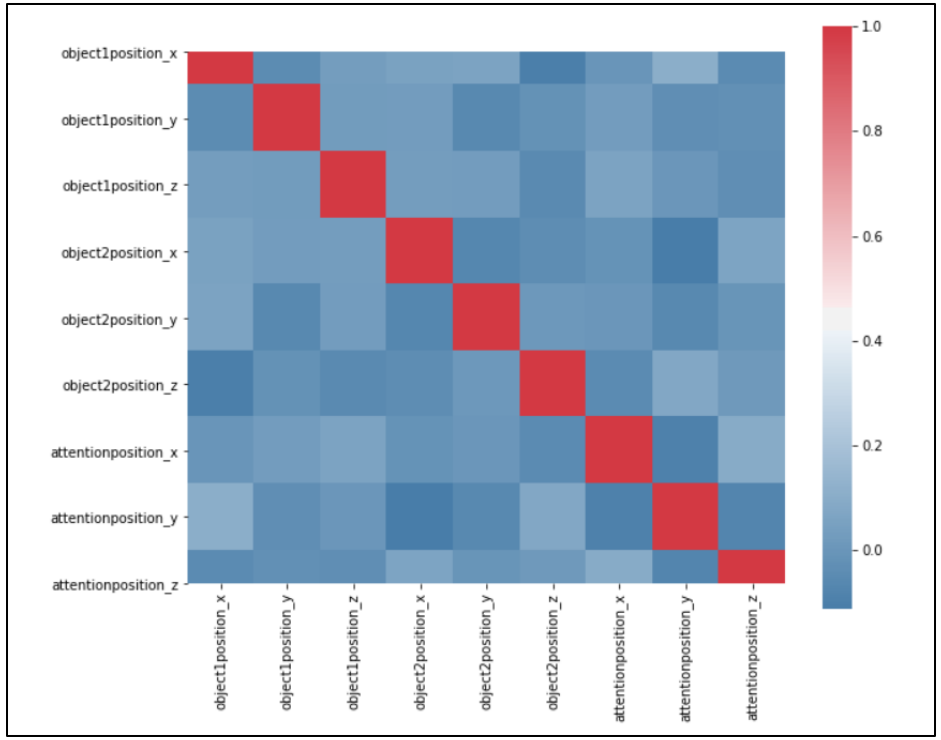

Fig.3 Correlation matrix

Pair Plot

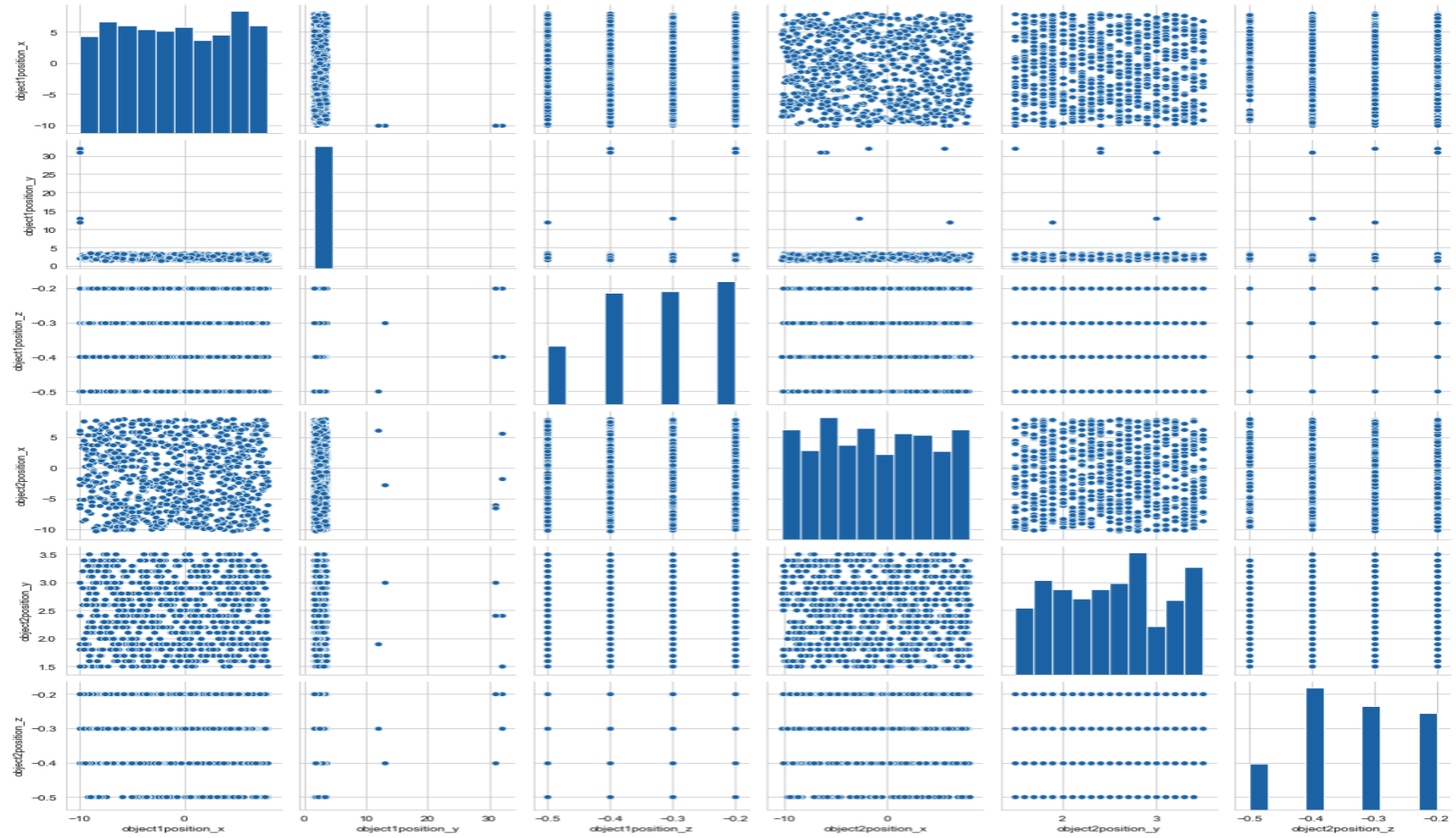

Fig.4 Pair plot

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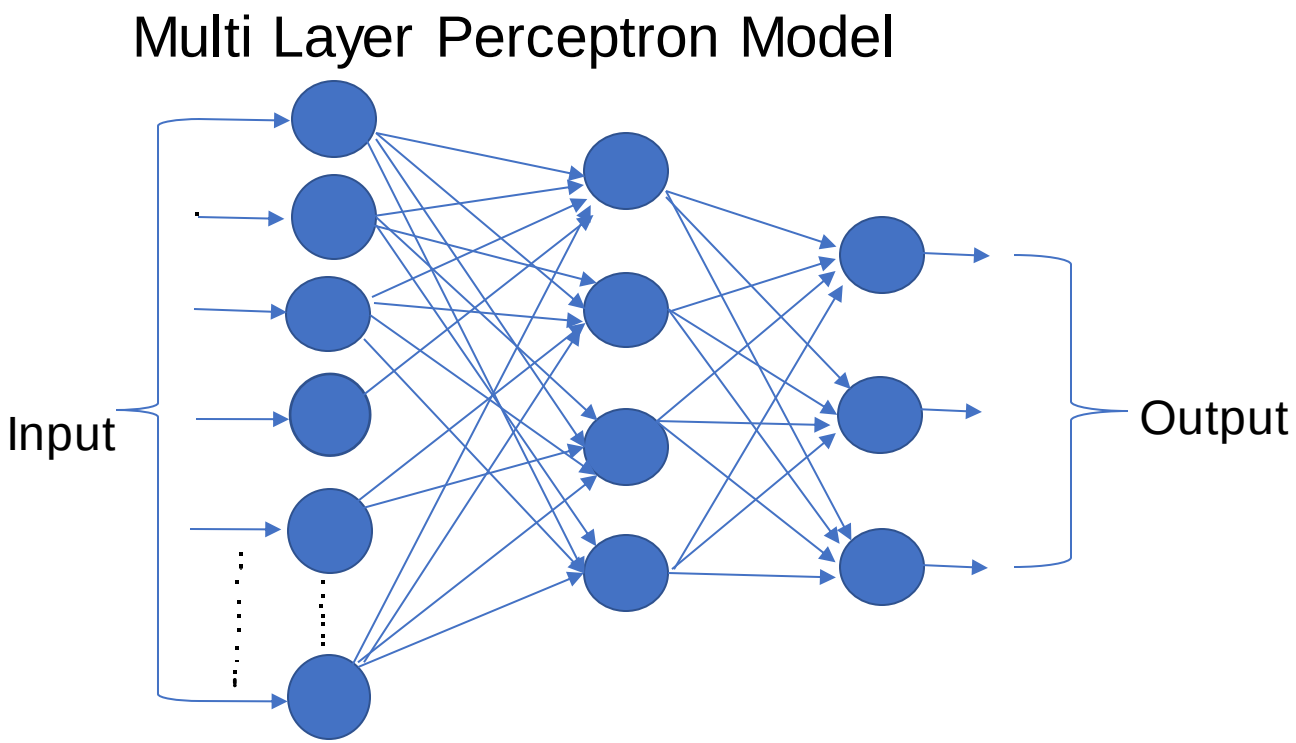
Model Planning

- So far we have seen the data shape, correlation between the features and the multi target labels.
- Now which model do need to use for the above features???
- From our research, for multi target labels we can use:
    - **Multi target regression(MTR) using Clustering and Decision trees**

        -Using trees for clustering, aka Predictive Clustering Trees (PCT)
    - **Neural Networks**

        - Multi layer perceptron

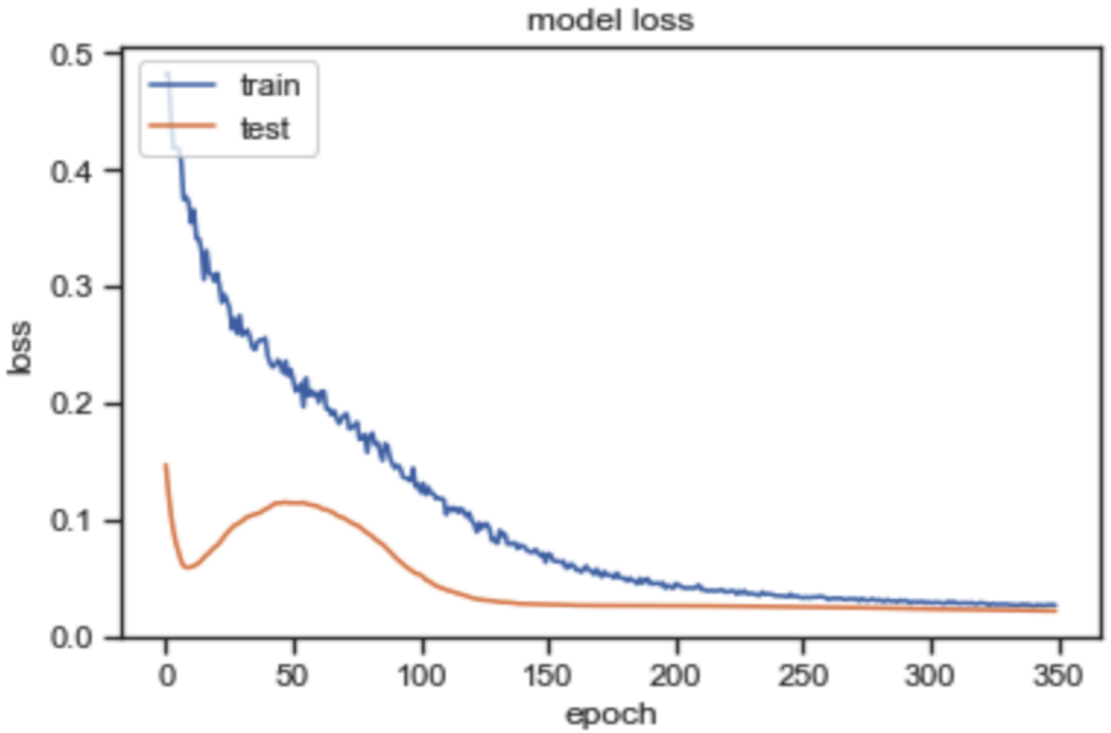
Model Building




```
model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 30)                930
_________________________________________________________________
dropout_1 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_2 (Dense)              (None, 16)                496
_________________________________________________________________
dropout_2 (Dropout)          (None, 16)                0
_________________________________________________________________
dense_3 (Dense)              (None, 8)                 136
_________________________________________________________________
dropout_3 (Dropout)          (None, 8)                 0
_________________________________________________________________
dense_4 (Dense)              (None, 3)                 27
=================================================================
Total params: 1,589
Trainable params: 1,589
Non-trainable params: 0
```

Model Evaluation



Activation Function : Tanh
Optimization Algorithm : Adam
Metric : mean square error

Training samples : 560
Validation samples : 240
Test samples : 200

RESULT

At the end of 400 epochs:

- Training error=0.0262
- validation error=0.0202

Predicted value = [-3 ,3.4 , -7.0]
Actual value = [-3, 2.3 , -7.9]

Resources Required

python

unity

lab

Libraries Used

- Keras
- Sklearn
- Numpy
- Pandas
- Matplotlib
- Seaborn
- mpl_toolkits

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Conclusion and Future work

This simulation is to test whether 3D attention points can be predicted or not.
But at the end we almost predicted the attention points with very small loss.

As of now Microsoft Holo lens 2 are not available in the market to experiment this project in the full-fledged 3D scene where user can walk through the virtual environment to produce the heatmap data of attention points.
So, once we lens will be available in the market, we plan to experiment this again with high accuracy.


Thank you so much !!
Stay home and stay safe
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References and Links

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[7] Hyrskykari, A., Majaranta, P. and R• aih• a, K.-J. From Gaze Control to Attentive Interfaces. Proc. HCII 2005, Las Vegas, NV, July 2005