Zero-shot Emotion Classification via Reinforced Self-training

@進捗報告
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Zero-shot Learning

- **Zero-shot learning (ZSL)**

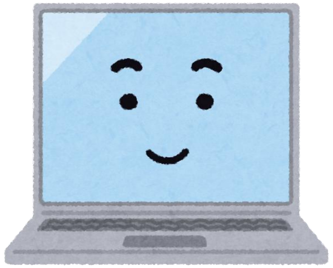
ZSL is a challenging task as no labeled data is available for unseen classes during training.

- **When we could use ZSL?**

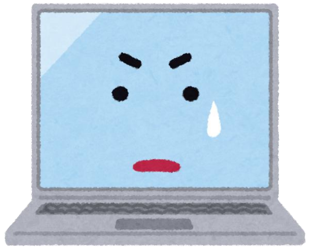
If we need **A more generalizable AI** that can even recognize non-observed classes

If we are **Lack of labled training data** labeling is a pain
or we even don't have the data at all

Zero-shot Learning

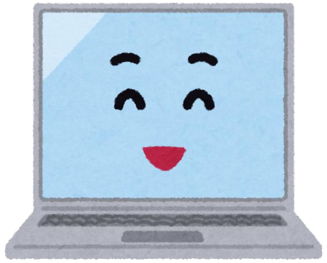


It's tiger! It's horse!
It's panda!
I have learned it!



You wanna me to
recognize zebra?
I'v never seen it!

The zebra is **horselike**, has
stripes like a tiger, and it is
black&white like a panda



Thank you for your
description!
So this is a zebra,right?

Zero-shot Learning

× **Semantic space** =

Feature space
extracted from Image

Semantic space
transformed from auxiliary information

So we do not need Zebra's image
we only need Semantic space about zebra

Zero-shot Learning

We need some form of auxiliary information

and this type of information can be of several types:

1) Attributes
2) Textual description
3) Class-class similarity

Can be converted to **semantic space**

Zero-shot Learning

Issues in ZSL

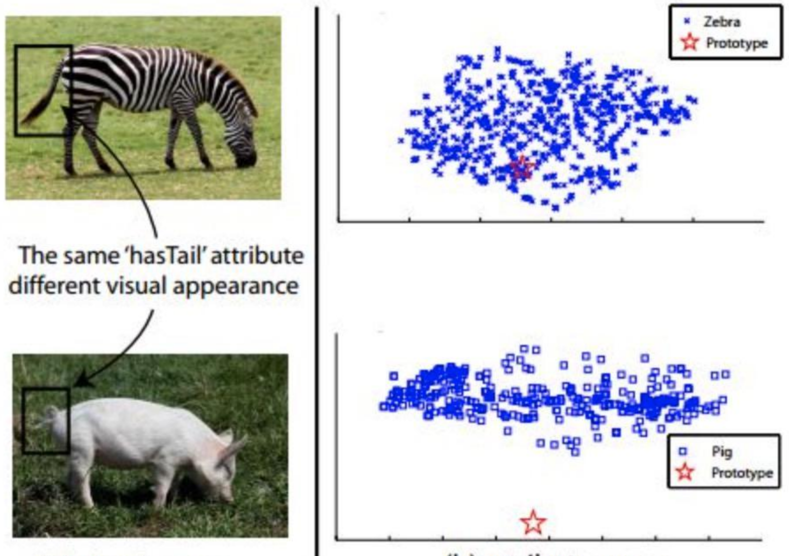
- **How to accurately define the description of the Zero-shot class**

how about learning it from the (unseen)test dataset?

- **Hubness problem**

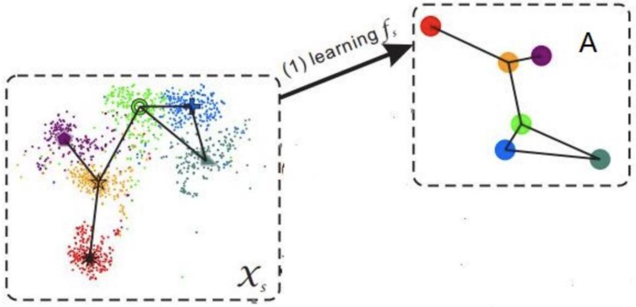
In high-dimensional space, some points will be the nearest neighbors of most points

- **Domain shift problem**



(a) visual space (b) attribute space

- **Semantic gap**

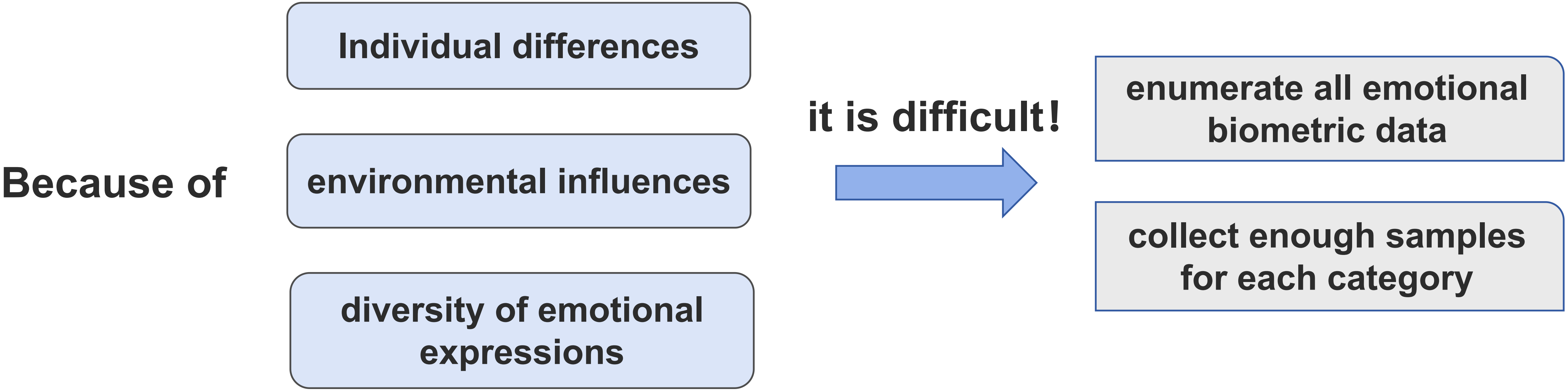


- **Semantic loss**

Zero-shot Learning for emotion classification

Complex, compounded emotional expressions are common!

*Ex. **happily surprised** and **angrily surprised**



Because of

Individual differences

environmental influences

diversity of emotional expressions

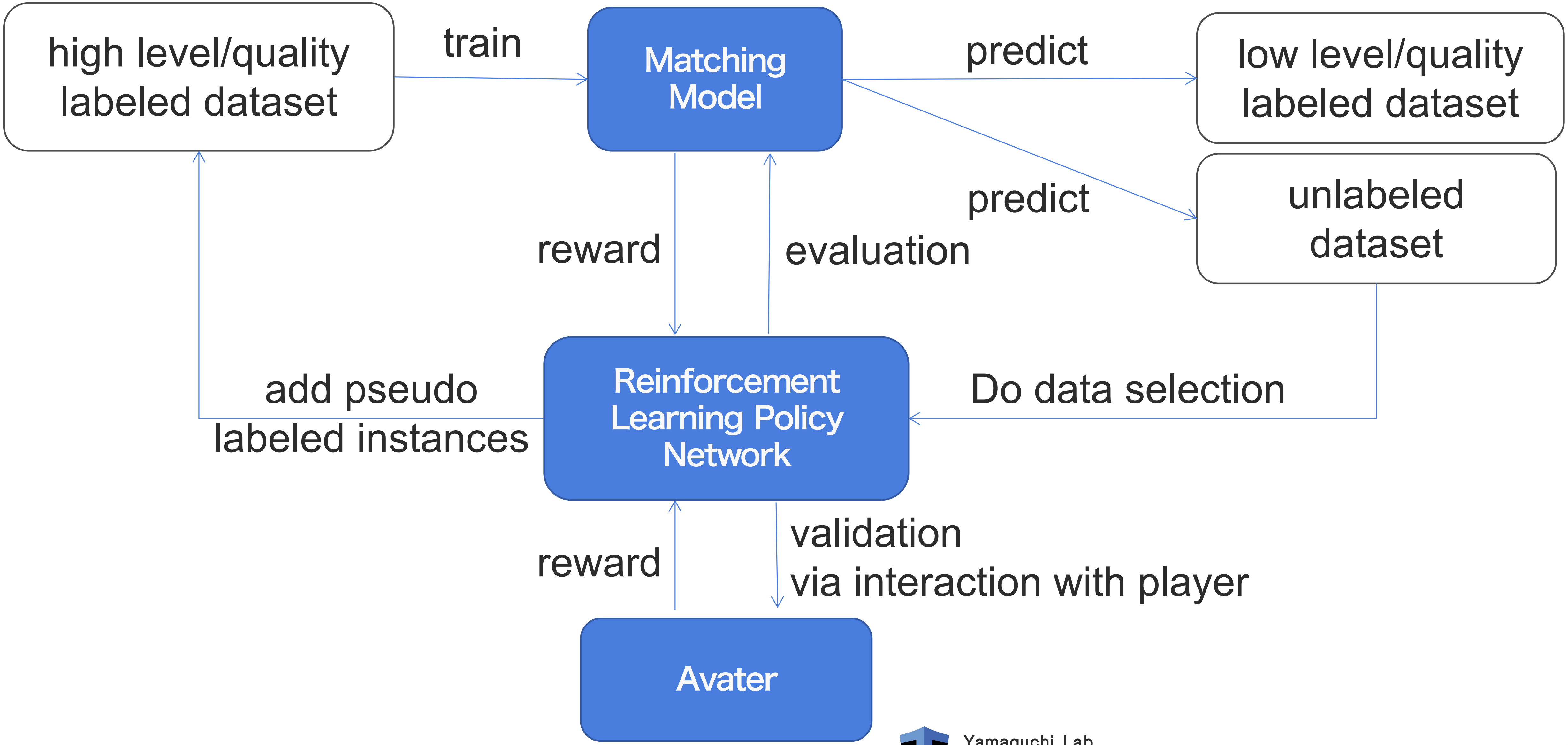
it is difficult!

enumerate all emotional biometric data

collect enough samples for each category

For the relatively rare samples of emotional expressions
It's just like unseen class! (So can we use Class-class similarity or sth..?)

Self-training and Reinforcement Learning Model


high level/quality labeled dataset
train
Matching Model
predict
low level/quality labeled dataset
predict
unlabeled dataset
reward
evaluation
add pseudo labeled instances
Reinforcement Learning Policy Network
Do data selection
reward
validation via interaction with player
Avater

Experiment Design

APP: VRChat

Participants: more than 20 groups of collaborators (3 people a group)

Used Raw Data: ECG | Audio(wav) | Eye tracking | Head position&rotation

Details:

One participant wear sensors and VR headset as a main talker

other two participants just wear VR headset and talk

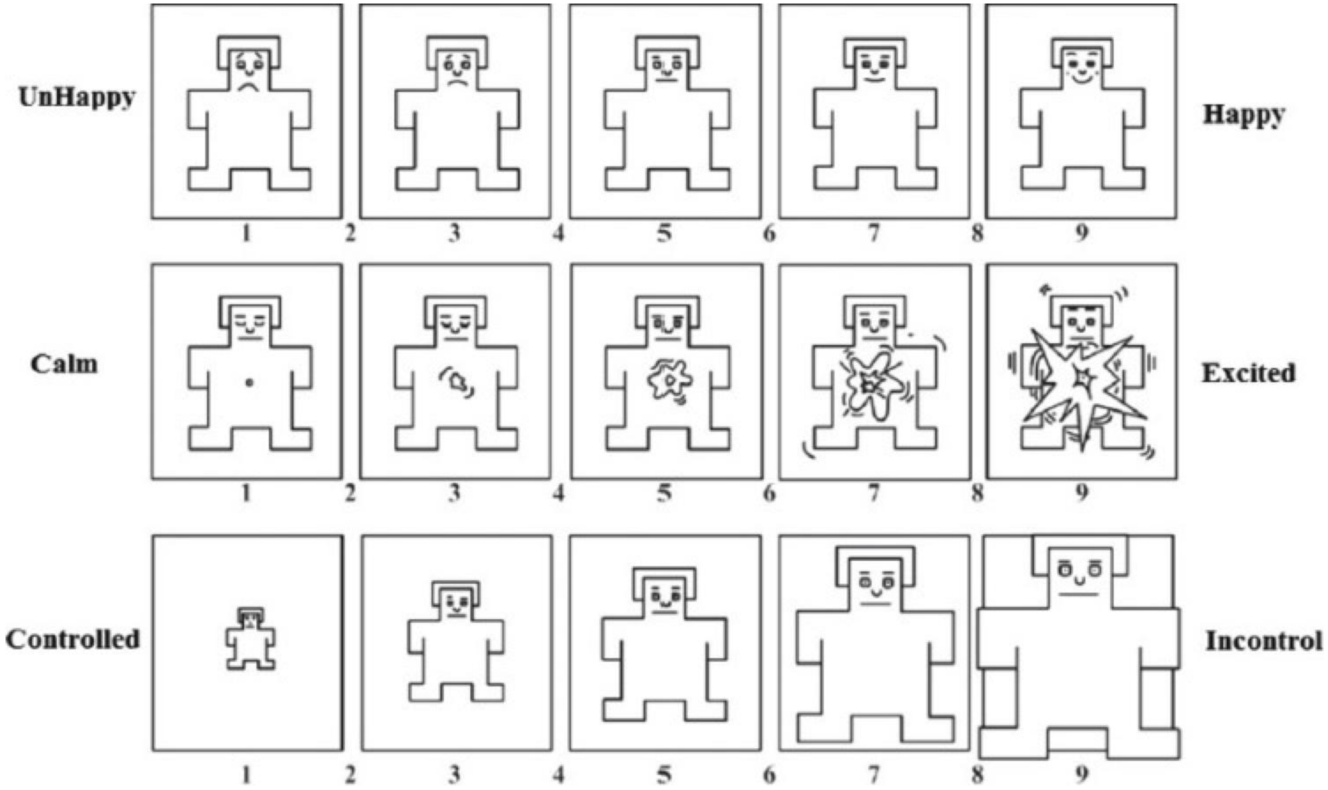
Each conversation lasted approximately **three minutes**

Topics:

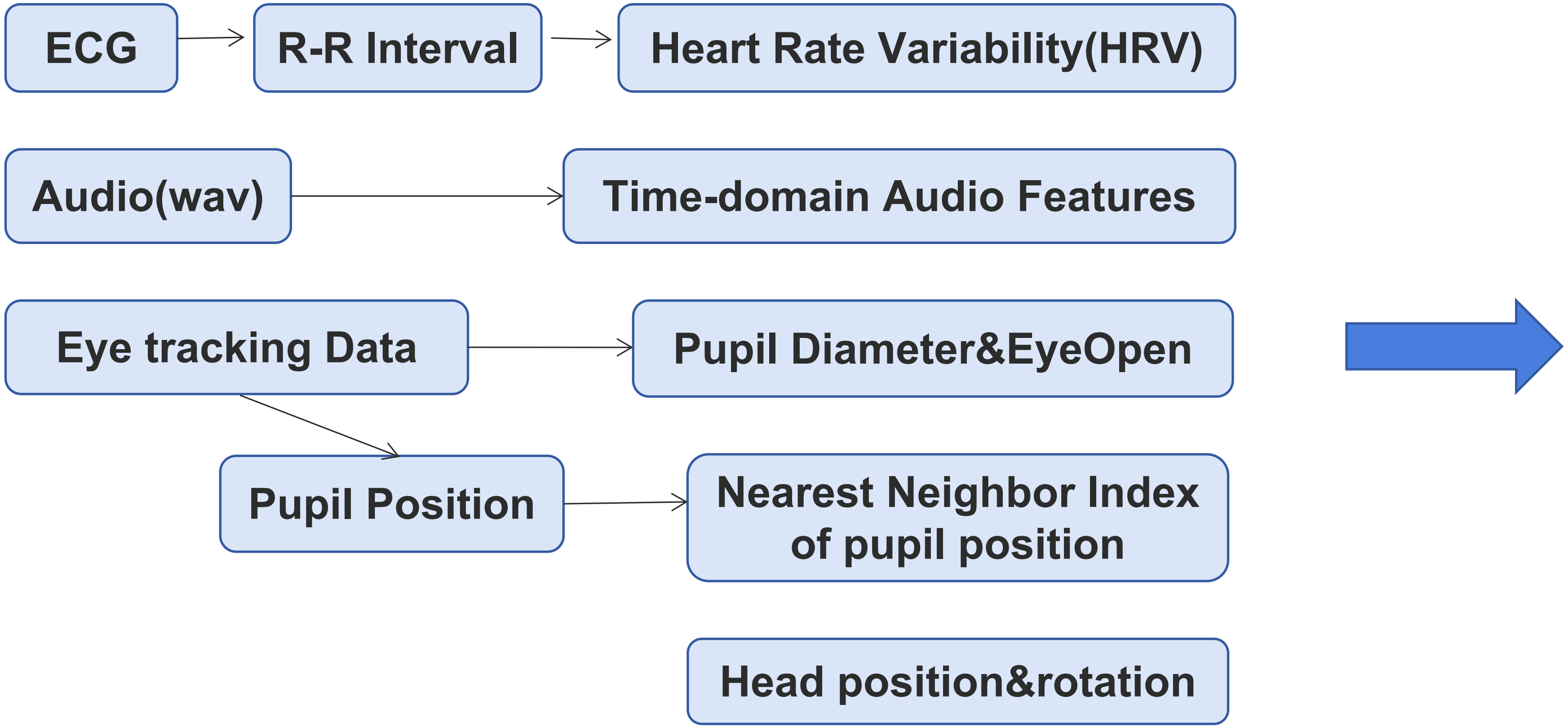
Talk about specific topics that are likely to cause emotional fluctuations or produce opposing positions

Experiment Design

I am not sure which questionnaire to use



Data-processing and Matching Model



ECG → R-R Interval → Heart Rate Variability(HRV)

Audio(wav) → Time-domain Audio Features

Eye tracking Data → Pupil Diameter&EyeOpen

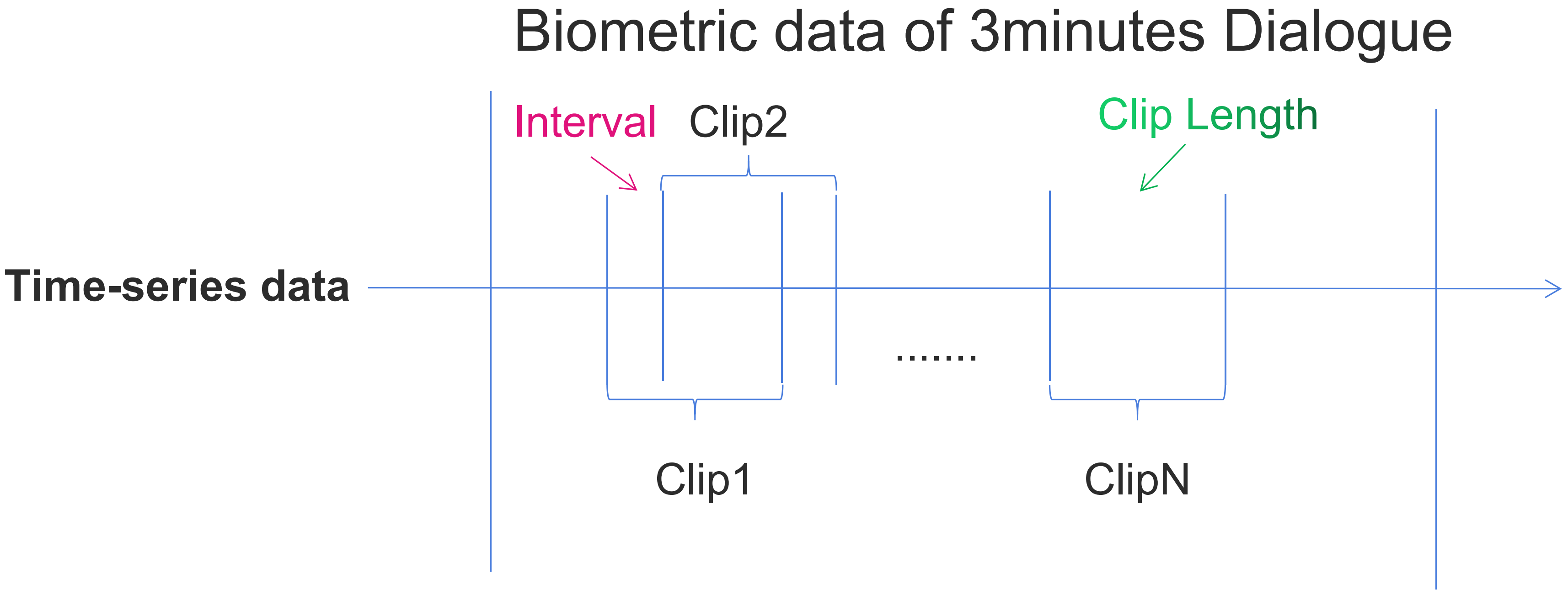
Eye tracking Data → Pupil Position → Nearest Neighbor Index of pupil position

Head position&rotation

Train class Matching Model

Reinforcement Learning for Self-training

Time-series data selection



*Ex. If set interval 1s, clip length 30s, we can get about 270 clips

Policy network

Train a policy network to decide whether select this clip or not

Reinforcement Learning Network

For Reinforcement Learning Network

(1)State:

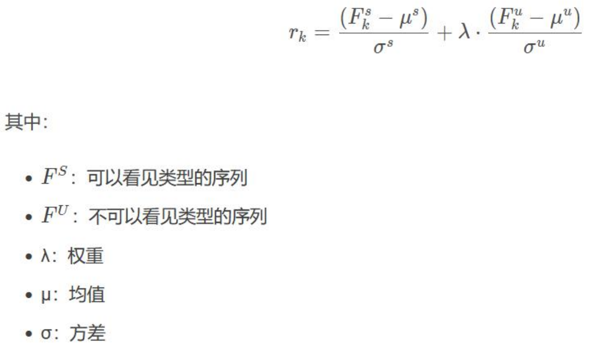
preprocessed biological data and confidence point

(2)Action:

Two class, whether choose this sample

(3)Reward:

Based on the model's performance on validation set



$$r_k = \frac{(F_k^s - \mu^s)}{\sigma^s} + \lambda \cdot \frac{(F_k^u - \mu^u)}{\sigma^u}$$

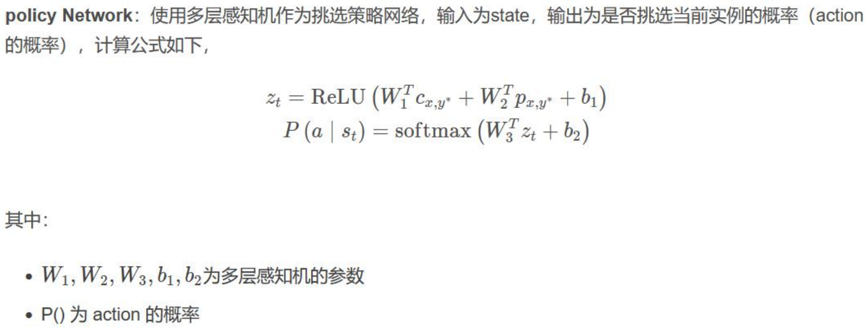
其中:

- F^S: 可以看见类型的序列
- F^U: 不可以看见类型的序列
- λ: 权重
- μ: 均值
- σ: 方差

(4)Policy Network:

Input is State

Output is Action's probability distribution



policy Network: 使用多层感知机作为挑选策略网络，输入为state，输出为是否挑选当前实例的概率（action 的概率），计算公式如下，

$$z_t = \mathrm{ReLU}\left(W_1^T c_{x,y^*} + W_2^T p_{x,y^*} + b_1\right)$$
$$P(a \mid s_t) = \mathrm{softmax}\left(W_3^T z_t + b_2\right)$$

其中:

- W_1, W_2, W_3, b_1, b_2为多层感知机的参数
- P() 为 action 的概率

Discussion

- How to collect **high quality data** to train a not bad Matching Model first
- What algorithm to use to train **Matching Model**
- What **Policy Network algorithm** to use
- How to **balance the reward and evaluation** of RL?
- How to design the **interaction between avater and player** in VR

Acknowledgment

Thank you for listening

ご清聴ありがとうございます

Related Work

There are extensive works proposed in **zero-shot image/text classification** task

Related Work

Zero-shot Text Classification via Reinforced Self-training

A Generalized Zero-Shot Framework for Emotion Recognition from Body Gestures

Why emotion and dialogue mood？

- VRにおける、複数人の対話の雰囲気や個人の感情を把握して適切な介入を行うことで、コミュニケーションを円滑させる対話支援アバターの開発を目指す。
- **The goal is to develop a dialogue support avatar in VR**

- 雰囲気工学では，多人数の会話場における雰囲気を分析することや，複数の会話エージェントや会話ロボットによる人工的な言語，非言語情報が作り出す会話場の雰囲気の分析を目指す

Shortcomings of the previous study

Shortcomings of the previous study

- Insufficient amount of experimental data
- individual differences appeared
- The means of feature extraction of the data needs to be improved
- Difficulty in confirming whether self-report accurately describe their own emotions
- Collaborators exposed to VR for the first time tend to show excitement

Question

如何保证收集到高质量的情感数据以训练出高质量的Matching Model

要用什么Policy Network算法
reward和evaluation的平衡怎么办

VR中avater和player的交互方式怎么设计
avater的evaluation/reward策略怎么设计