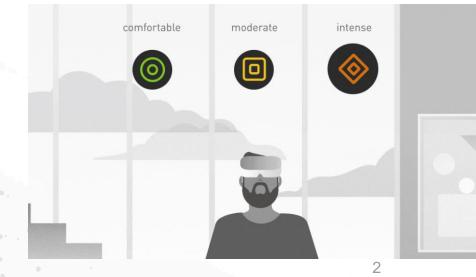
Virtual Reality Application Comfort Level Rating Evaluator

LYU2201 Final Year Project Term2 Presentation Junjie XIE Supervised by Prof. Michael R. Lyu

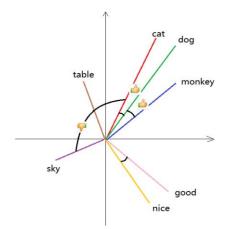
Review

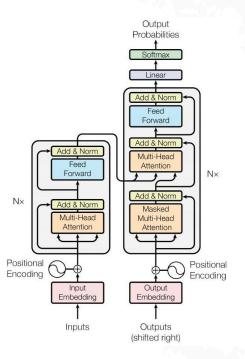
- VR application comfort levels rating: Comfortable, Moderate, Intense
- Determining the comfort level of VR applications is time-consuming
- Provide a quick tool to evaluate the application comfort level
- Using description to make prediction



Text Encoder

- Count Vector
- TF-IDF Vector
- Word Embedding
- Transformer



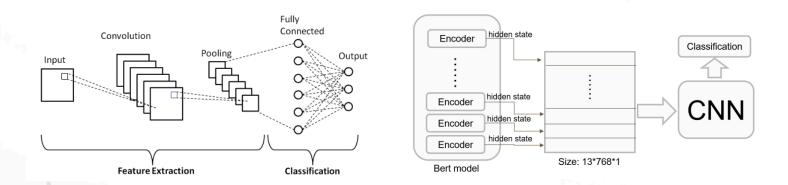


Projection of the embedding vectors to 2D 3

Transformer encoder and decoder architecture

Model

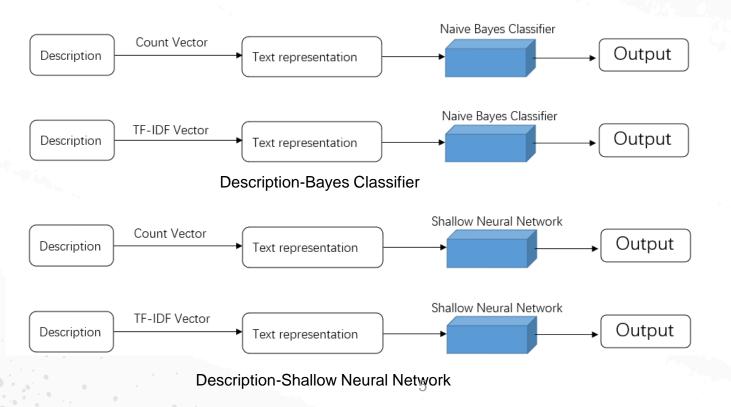
- Bayes Classifier
- Shallow Neural Network
- Convolutional Neural Network
- Transformer-CNN



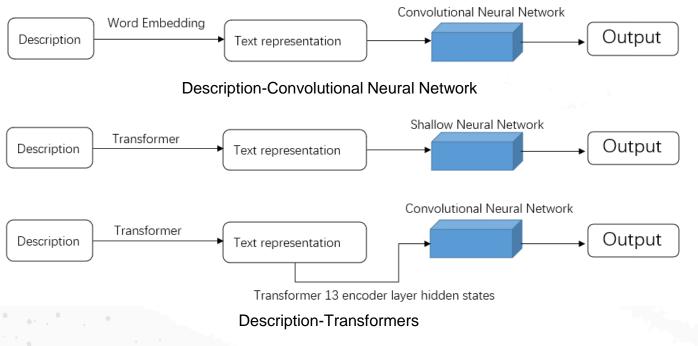
Convolutional Neural Network

Transformer-CNN





Experiment



Experiment Result

Model	Accuracy
Description Bayes Classifier (Count Vector)	0.7207
Description Bayes Classifier (Count Vector Oversampled)	0.6723
Description Bayes Classifier (TF-IDF Vector)	0.6301
Description Bayes Classifier (TF-IDF Vector Oversampled)	0.5963

Description-Bayes Classifier

Model	
Description-Shallow Neural Network (Count Vector)	0.6483
Description-Shallow Neural Network (Count Vector Oversampled)	
Description-Shallow Neural Network (TF-IDF Vector)	
Description-Shallow Neural Network (TF-IDF Vector Oversampled)	0.6321

Description-Shallow Neural Network

Model	Accuracy
Description-Convolutional Neural Network	0.7074
Description-Convolutional Neural Network (Oversampled)	0.7665

Model	Accuracy
Description-Transformer	0.8316
Description-Transformer (Oversampled)	0.8325
Description-Transformer-CNN	0.8432
Description-Transformer-CNN (Oversampled)	0.8398

Description-Convolutional Neural Network

Description-Transformers

To improve

- Reviews
- Images
- Videos



KMPace.921 Mar 12 at 3:41 AM

Hard to navigate

Even though it's hard to navigate & I certainly don't understand any of the other levels except for the feeling of the top floor once you just go straight to the top floor it's a cool experience

•••

Review sample



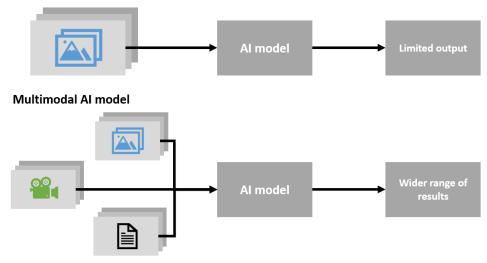
Image sample



Video sample

Multimodal Machine Learning

- Different modality data
- Text, Image, Video, Audio
- Internal structure and Data transformation are different



Unimodal AI model

Fusion scheme

- Goal: Obtain more comprehensive information
- Fusion: Combine features from different modalities
- Early fusion
- Mid fusion
- Late fusion

Early Fusion

- Features from different modalities are fused in the input layer.
- Early fusion methods directly integrate information from different modalities into a complete feature vector.
- Usually suitable for cases where the modality differences are small, and the features are relatively simple.

Mid Fusion

- Fuse the features of different modalities in an intermediate layer.
- Improve the representation of features.
- Suitable for cases where the modality differences are large and the features are complex.

Late Fusion

- The features of different modalities are firstly fed into different classifiers for processing, and finally the results of different classifiers are fused.
- Avoid the conflict of features of different modalities.
- Suitable for the cases where the modality differences of data sources are large, the features are complex, but their correlation are strong.

Text-Text Learning

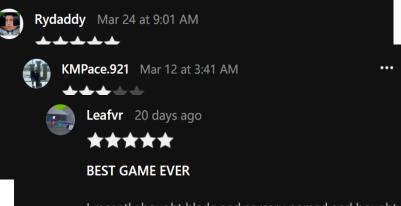
Blade & Sorcery: Nomad

18+ 18+ Extreme Violence

★ ★ ★ ★ 1 32,303 Ratings

The era of the VR weightless, wiggle-sword combat is over. Blade & Sorcery: Nomad is a medieval fantasy sandbox like no other, focusing on melee, ranged and magic combat that fully utilizes a unique and realistic physics driven interaction and combat system. Built exclusively for VR, collisions are dictated by fine hitboxes, objects have weight and follow the laws of physics, creatures have full body physics and presence, and blades can be used to penetrate soft materials or deflect magic. In Blade & Sorcery: Nomad, the combat is limited only by your own creativity. Choose your weapon, choose your stance, choose your fighting style; Be the powerful warrior, ranger or sorcerer you always dreamed of becoming!

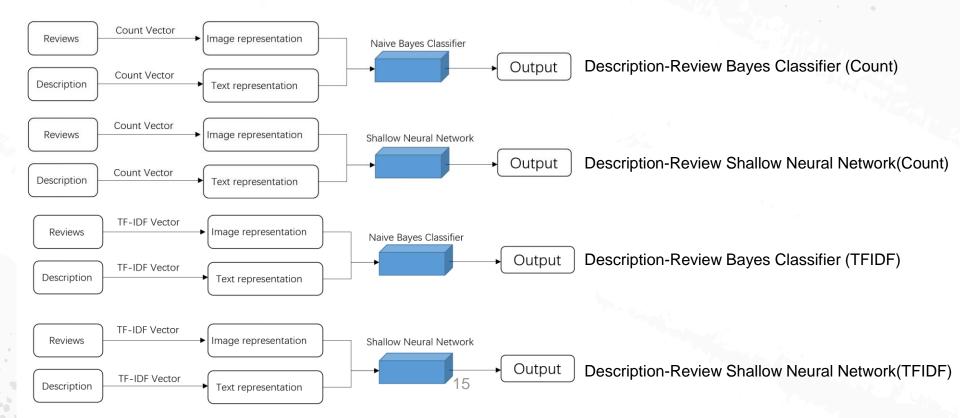
App descriptions



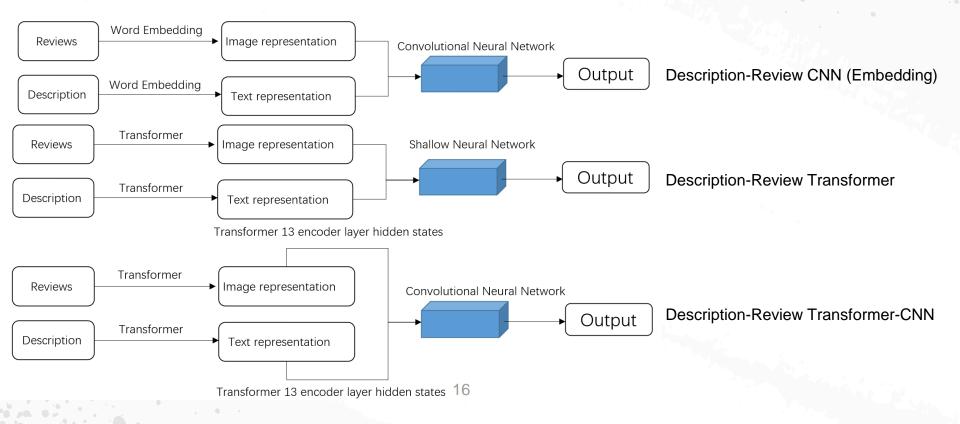
I recently bought blade and sorcery nomad and bought it for the mods but I find myself playing for hours in sandbox mode and in the dungeon mode having the most fun ever I recommend buying this and the graphics look amazing

User reviews

Text-Text Learning - early fusion



Text-Text Learning – early fusion



Model	Accuracy
Description Bayes Classifier (Count Vector)	0.7207
Description Bayes Classifier (Count Vector Oversampled)	0.6723
Description Bayes Classifier (TF-IDF Vector)	0.6301
Description Bayes Classifier (TF-IDF Vector Oversampled)	0.5963

Text-text learning result

Model	Accuracy	
Description-Review Bayes Classifier (Count Vector)	0.7103	
Description-Review Bayes Classifier (Count Vector Oversampled)	0.6981	
Description-Review Bayes Classifier (TF-IDF Vector)	0.6502	
Description-Review Bayes Classifier (TF-IDF Vector Oversampled)	0.6233	

Description-Review Bayes Classifier

Model	Accuracy	
Description-Review SNN (Count Vector)	0.6501	
Description-Review SNN (Count Vector Oversampled)	0.6788	
Description-Review SNN (TF-IDF Vector)	0.6455	
Description-Review SNN (TF-IDF Vector Oversampled)	0.6333	

Description-Review Shallow Neural Network

Model	
Description-Shallow Neural Network (Count Vector)	0.6483
Description-Shallow Neural Network (Count Vector Oversampled)	
Description-Shallow Neural Network (TF-IDF Vector)	0.6192
Description-Shallow Neural Network (TF-IDF Vector Oversampled)	0.6321

17

Text-text learning result

Model	Accuracy
Description-Convolutional Neural Network	0.7074
Description-Convolutional Neural Network (Oversampled)	0.7665

Model	Accuracy	iter (
Description-Review CNN (Word Embedding)	0.7221	Santa .
Description-Review CNN (Word Embedding Oversampled)	0.7443	

Description-Review Convolutional Neural Network

Model	Accuracy	
Description-Review Transformer	0.8401	
Description-Review Transformer (Oversampled)	0.8356	
Description-Review Transformer-CNN	0.8397	
Description-Review Transformer-CNN (Oversampled)	0.8434	

Description-Review Transformers

Model	Accuracy
Description-Transformer	0.8316
Description-Transformer (Oversampled)	0.8325
Description-Transformer-CNN	0.8432
Description-Transformer-CNN (Oversampled)	0.8398

Text-Text-Image

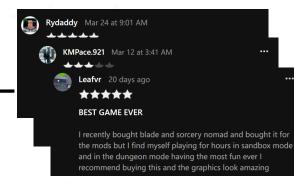
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★ ★ ★ 🖈 🔰 32,303 Ratings

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App descriptions

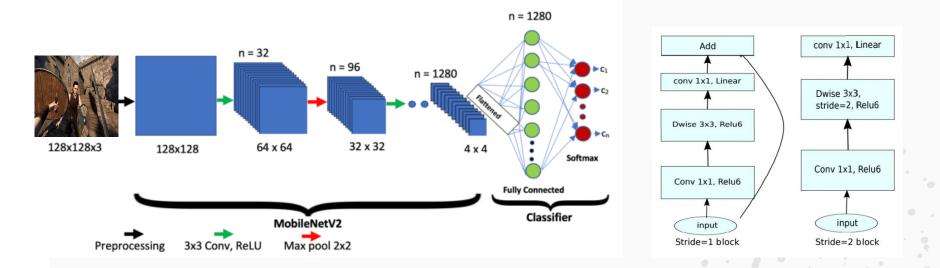


User reviews



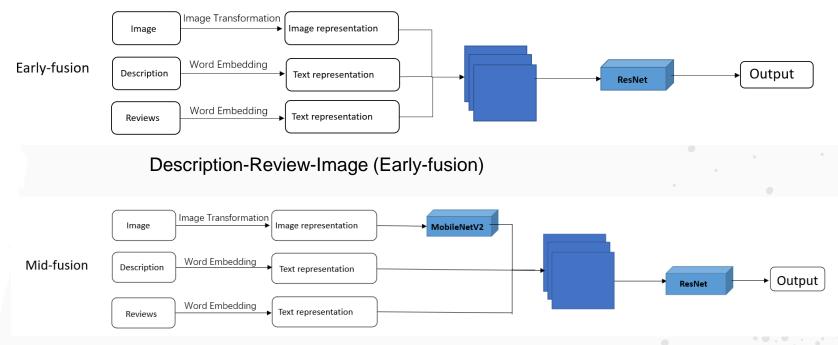
Images

Image Encoder - MobileNetV2



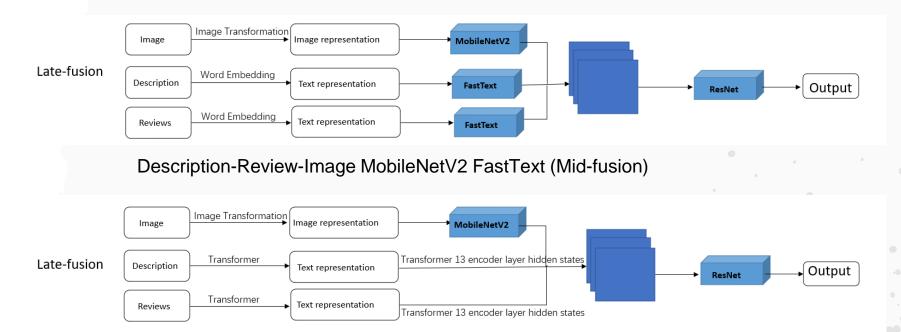
Convolutional neural network architecture built on an inverted residual structure

Text-Text-Image



Description-Review-Image MobileNetV2 (Mid-fusion)

Text-Text-Image



Description-Review-Image MobileNetV2 Transformer (Late-fusion)

Text-Text-Image Result

Model	Accuracy
Description-Review-Image (Early-Fusion)	0.7322
Description-Review-Image MobiletNetV2 (Mid-Fusion)	0.7613
Description-Review-Image MobiletNetV2 FastText (Late-Fusion)	0.7829
Description-Review-Image MobiletNetV2 Transformer (Late-Fusion)	0.8475

Description-Review-Image Learning

Text-Text-Video

Blade & Sorcery: Nomad

★ ★ ★ 🖈 🍿 32,303 Ratings

The era of the VR weightless, wiogle-sword combat is over. Blade & Sorcery: Nomad is a mediaval fantasy sandbox like no other, focusing on melee, nanged and magic combat that fully utilizes a unique and realistic physics driven interaction and combat system. Built exclusively for VR, collisions are dictated by fine hiboxes, objects have weight and follow the laws of physics, creatures have full body physics and presence, and balads can be used to penetrate soft materials or deflect magic. In Blade & Sorcery, Nomad, the combat is limited only by our own creativity. Choose your weapon, choose your stance, choose your fighting style; Be the powerful warrior, ranger or sorcere you always dreamed of becoming!

App descriptions

 Rydaddy
 Mar 24 at 9:01 AM

 Mar 12 at 3:41 AM
 ...

 Leafvr
 20 days ago

 Leafvr
 20 days ago

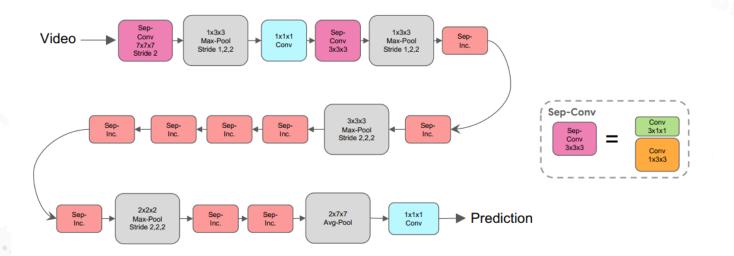
 I recently bought blade and sorcery nomad and bought it for the mods but 1 find myself playing for hours in sandbox mode and in the dungeon mode having the most fun ever 1 recommend buying this and the graphics look amazing

User reviews

BLADE SORCER

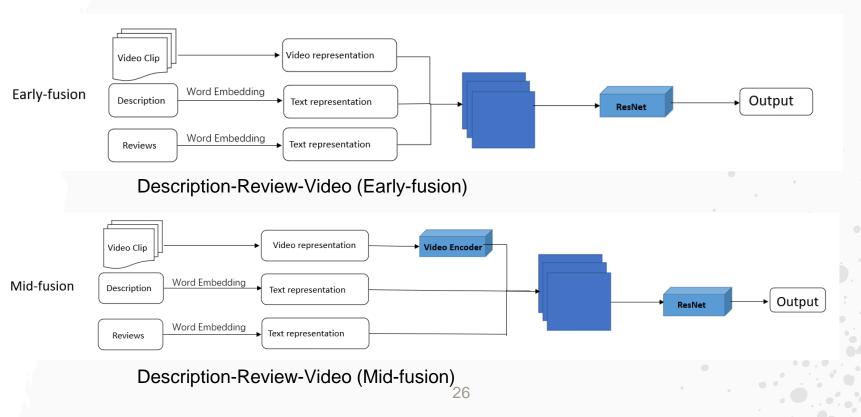
App video

Video Encoder S3D (Separable 3D convolutions)

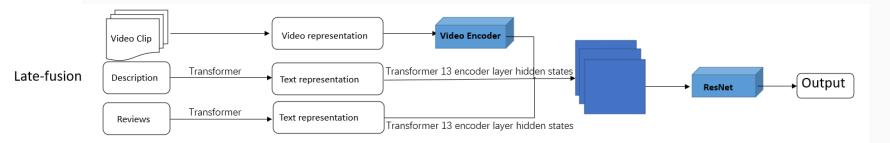


a single convolution can be divided into two or more convolutions to produce the same output

Text-Text-Video



Text-Text-Video



Description-Review-Video (Late-fusion)

Text-Text-Video learning result

Model	Accuracy
Description-Review-Video Cross Encoder (Early-Fusion)	0.8398
Description-Review-Video Cross Encoder (Mid-Fusion)	0.8492
Description-Review-Video Transformer (Late-Fusion)	0.8514

Conclusion

- Multiple modality information fed to our model is effective.
- And the more modality information the model is fed, the more positively correlated the final accuracy of the models.
- The transformer model fed with review, description, and video using late fusion has the highest accuracy 85%.

Discussion

- Qualified comfort level rating evaluator to help the users, developers, and platforms.
- To further improve our model, utilizing information such as the category tags, the music from the application.

Acknowledgement

 I would like to express my deep gratitude to my supervisor, Professor Michael, and Ms. Shuqing, one of Michael's PhD students, for their guidance and invaluable advice in helping me throughout this final year project.

Thank You!

Q&A