Privacy-Conscious Fall Detection

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ABSTRACT

Falling is an important safety concern for the elderly. However, monitoring videos 24/7 for fall detection causes privacy and security concerns. For this research, we collected a dataset of and used existing deep learning techniques to accurately detect falls.

BACKGROUND

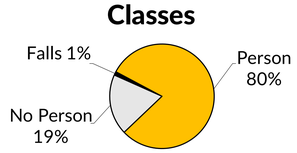
- 1 in 3 people over 65 fall each year
- 5th leading cause of death: **Unintentional Injuries**
- Of which 66% are caused by falls:

METHODOLOGY

Dataset

Total Images: **31,774**

Classes

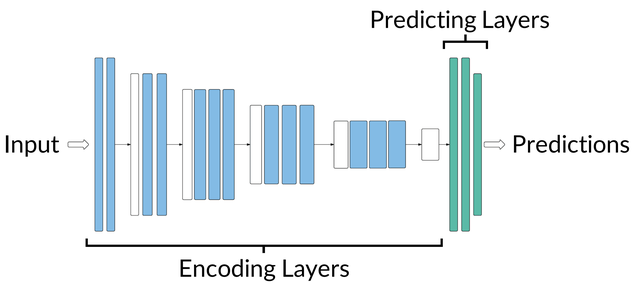


Examples

Fall | Person | No Person

Architecture and Models

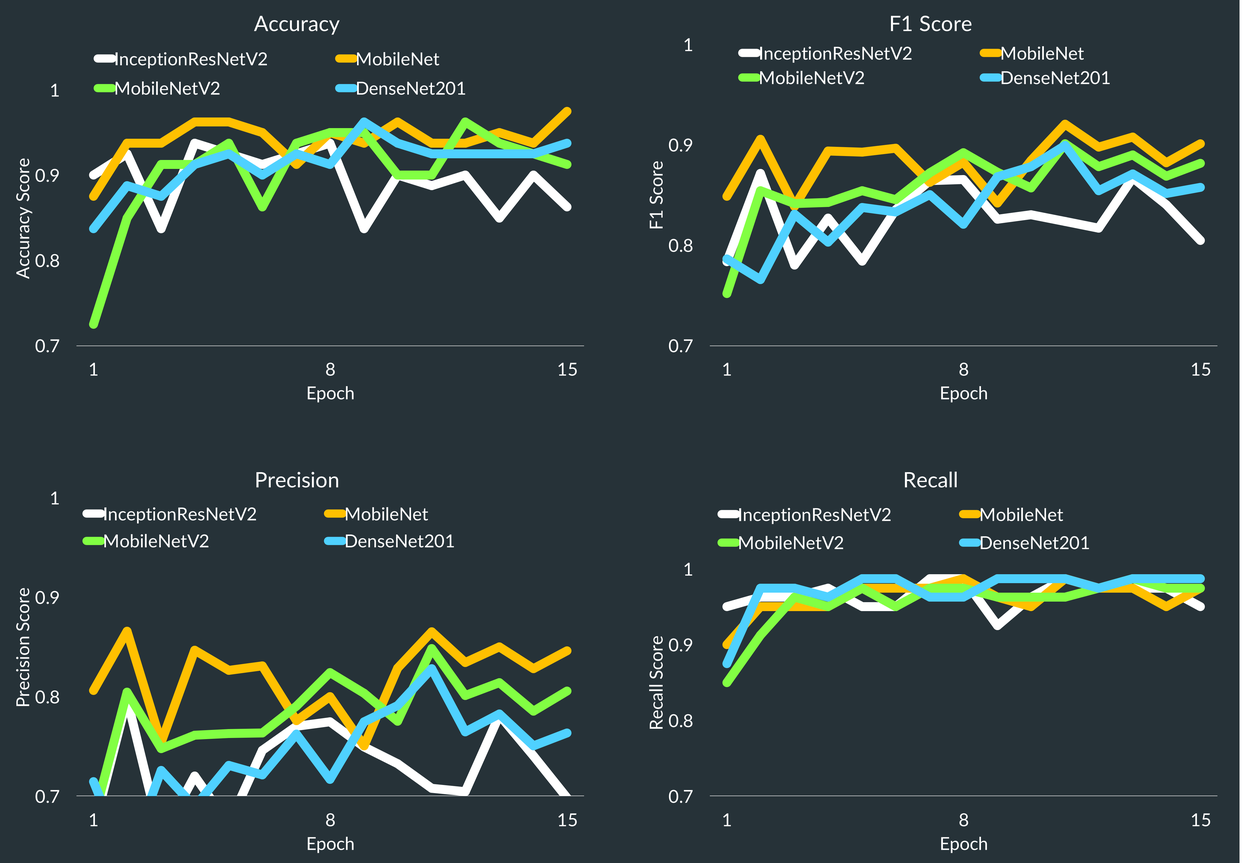
- Implemented 9 models (see Results table)
- Base Model: Encoder trained on ImageNet
- Prediction Layer: Custom prediction layer trained on our dataset



- Because of the small amount of fall images available, the encoders are pretrained on ImageNet and prediction layers retrained with our dataset.

Deep learning algorithms can accurately detect fallen people in images

Training Validation Scores of Best Models



Datasets used

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3. V. Delaitre, I. Laptev, and J. Sivic, "Recognizing human actions in still images: a study of bag-of-features and part-based representations," in bmvc, 2010, updated version, available at http://www.di.ens.fr/willow/research/stillactions/.
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RESULTS

Model	Parameters ↓	Accuracy ↑	F1 Score ↑	Precision ↑	Recall ↑
MobileNetV2	**3.5 M**	**0.950**	**0.925**	0.730	0.962
MobileNet	4.3 M	0.938	0.904	0.627	0.913
InceptionResNetV2	55.9 M	0.887	0.846	0.632	0.463
DenseNet201	20.2 M	0.900	0.842	0.659	0.962
InceptionV3	23.9 M	0.925	0.838	0.722	**1.000**
Xception	22.9 M	0.900	0.829	0.767	0.950
ResNet152V2	60.4 M	0.938	0.782	0.845	0.975
VGG19	143.7 M	0.788	0.742	**0.862**	**1.000**
ResNet152	60.4 M	0.613	0.531	0.749	0.962

- Due to the small number of 'Fall' images, large models are overfitting
- The poor performance of the large models also can be attributed to the highly specific feature extraction for ImageNet Dataset
- Thus, the encoder component of the small models are more generalizable
- Having a smaller number of parameters are advantageous as requires less computation

CONCLUSION AND FUTURE WORK

- Existing deep learning techniques are sufficient to accurately detect falls
- MobileNetV2 performed best when trained to optimize the F1 score and accuracy
- Lower parameter numbers correlated with better performances – suggests a higher applicability to novel tasks
- Future work includes
  - Testing more versus less custom layers
  - Testing with different image conditions (e.g., light level, occlusion, disability aids)

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