CSCI 475 PROJECT PROPOSAL: USING ML FOR FALL DETECTION

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ABSTRACT

Our project aims to develop a machine learning model that utilizes image frames to detect falls in real-time. We will be leveraging the URFD dataset, which provides video frames labeled for fall and non-fall instances, to create a reliable and efficient fall detection system.

1 INTRODUCTION/MOTIVATION

Falls among the elderly, either at their residence, or a care center, are a significant health and safety concern, often leading to severe injuries and decreased quality of life. The goal of our project is to develop a machine learning-based fall detection system that can improve response times in emergencies. By focusing solely on image frames from the rich URFD dataset, we intend to create a robust model capable of accurately classifying fall and non-fall instances.

2 BASELINE OR INITIAL EXPERIMENTS

To start, we will conduct exploratory data analysis on the URFD dataset to understand how the fall and non-fall instances are distributed. We first plan to create 1 second frames from the videos and label them 'fall' vs 'not fall', effectively creating a dataset of images out of URFD clips. Our initial experiments will involve training a simple Convolutional Neural Network (CNN) on static images to establish a baseline for our model's performance. We will, on a deed basis, evaluate the model's performance on accuracy and loss metrics to ensure a solid foundation for further development.

3 FINAL EXPERIMENTS

After establishing our baseline, we will extend our approach by implementing focusing on accuracy, precision, and recall metrics to assess and improve the model's performance. If time permits, we will also experiment with data augmentation techniques (rotating the image, cropping, jittering the colors, etc.) to enhance the robustness of our model.

4 FINAL GOALS & EVALUATION

By the end of this semester, we hope to achieve a functional fall detection model that performs with at least 85% accuracy on the validation set. We will evaluate our experiments based on accuracy, precision, and recall metrics, ensuring a comprehensive understanding of our model's performance. We plan to report our results for every iteration and improvements we make, thus, we are targeting a more ambitious outcome. Moreover, we plan to build a minimalistic interactive UI to upload a new image and be provided with the model's prediction.

5 RELATED WORK

A relevant study by Salimi et al. (2022) explores the use of Deep Neural Networks for human fall detection based on pose estimation. In their work, the authors proposed a novel approach that combines

Fast Pose Estimation with Time-Distributed Convolutional Long Short-Term Memory (TD-CNN-LSTM) and 1D Convolutional Neural Network (1D-CNN) models. Their method achieved high accuracies of 98Our current work builds on these findings by similarly focusing on machine learning models for fall detection, but with a focus on using static image frames from the URFD dataset. While Salimi et al. (2022) leveraged pose estimation, our approach aims to explore whether reliable fall detection can be achieved using Convolutional Neural Networks (CNNs) on image frames alone. We will begin by establishing a baseline model using a simple CNN, and based on the results, we may incorporate advanced techniques like those used by Salimi et al. (2022) to improve the accuracy and robustness of our system. Ultimately, our goal is to achieve a real-time, efficient fall detection system that could also be adapted for practical use, similar to the objectives highlighted in their research.

6 Data & Technical Requirements

We will utilize the URFD dataset, which contains images labeled for fall and non-fall instances. The primary software libraries will include TensorFlow or PyTorch for model development, along with pandas for data manipulation and OpenCV for image processing. We are considering a GPU-enabled environment at Google Collab for training our models.

References

Bogdan Kwolek and Michal Kepski. Human fall detection on embedded platform using depth maps and wireless accelerometer. *Computer Methods and Programs in Biomedicine*, 117(3):489–501, 2014. ISSN 0169-2607. doi: 10.1016/j.cmpb.2014.09.002.

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