FALL DETECTION

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CONCEPT OF OPERATIONS

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CONCEPT OF OPERATIONS
FOR
FALL DETECTION

TEAM <56>

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1. Executive Summary

Improvements in fall detection software are beneficial in providing life-saving help by notifying emergency services as soon as possible. Unfortunately, current programs are not accurate and fast enough to meet this task. The proposed system must be able to detect falling motion from humans within video footage at an appropriate frame rate and be able to distinguish between falls and other similar motions. It should also be able to reliably handle interference by the presence of more people and other moving entities. This system utilizes code from pose estimation and previous fall detection software that have proven successful. This project seeks to improve the shortcomings of fall detection software and provide expanded capabilities.

2. Introduction

Training AI to identify human actions is an area of interest for computer scientists with a variety of applications. Action recognition is beneficial in safety, where it is important to handle life-threatening situations quickly. Falls are especially dangerous in areas with an absence of people, or the victim is not treated quickly enough. The objective of this project is to improve the accuracy and speed of preexisting fall detection software.

2.1. Background

Fall detection would allow emergency services to help the victim as soon as possible. However, current AI has difficulty differentiating between falling and other actions.

2.2. Overview

There is already work in fall detection software, however, there is still room to improve on its identification speed and accuracy. Many methods take too long to process video data and it is easy for AI to make mistakes. If this is rectified, then it would benefit the safety of humans and save lives.

2.3. Referenced Documents and Standards

- Fall Detection using Pose Estimation: https://towardsdatascience.com/fall-detection-using-pose-estimation-a8f7fd77081d
- An Overview of Human Pose Estimation with Deep Learning: https://medium.com/beyondminds/an-overview-of-human-pose-estimation-with-deep-learning-d49eb656739b
- History of Keypoint Detection in Computer Vision: https://medium.com/@SeoJaeDuk/history-of-keypoint-detection-in-computer-vision-be798a32ff4a
- Action Recognition: https://paperswithcode.com/task/action-recognition-in-videos
- What is Action Recognition: https://chooch.ai/computer-vision/what-is-action-recognition
- Action Recognition in Video: https://uwaterloo.ca/vision-image-processing-lab/research-demos/action-recognition-video
- Using Artificial Intelligence to detect and prevent falls: https://hospitalnews.com/using-artificial-intelligence-to-detect-and-prevent-falls/
- Fall Detection: https://viso.ai/application/fall-detection/
- Detecting & Preventing Falls with Artificial Intelligence: https://www.virtusense.ai/blog/detecting-preventing-falls-with-artificial-intelligence

3. Operating Concept

3.1. Scope

The fall detection system would take recordings of humans and identify which person has fallen. The system should function when given videos with lots of people and scenarios where a person is alone, such as at night.

3.2. Operational Description and Constraints

Video is supplied to the video processing system, then the program will identify and mark people with bounding boxes and key points. The fall-detection system determines if a person has fallen when they sustain certain conditions over a set period. If detected, the program will record that fall has occurred.
The main constraint is that test videos do not cover every potential scenario, which makes it more difficult to test the system for flaws.

3.3. System Description

The four subsystems focus on video processing, pose estimation, fall detection, and output. Video processing is where the video input is converted into a usable form for the subsequent steps. Pose estimation is where the program finds the people in the video and applies key points and bounding boxes onto their bodies. Fall detection is where conditions are checked on each person to see if they have fallen. Output is where the data collected is sent to external processes, our system will only display how many falls were detected.

3.3.1. Video Processing

The video processing system converts video into a form usable by the pose estimation system. It can also handle live video feeds for applications discussed in the Scenarios section.

3.3.2. Pose Estimation

The pose estimation system identifies people in a video and overlays bounding boxes and key points for use in the fall detection system. Several programs were examined to determine their viability for our project: OpenPose, AlphaPose, and OpenPifPaf.

OpenPose needed training files that were no longer available. Fortunately, those files were found, and it was able to process a video. OpenPifPaf was promising because an author had used it in their fall detection system. However, difficulties running the required programs prevented its use. There was little trouble running AlphaPose, making it the most straightforward of the three.

Their accessibility makes OpenPose and AlphaPose viable candidates for our pose estimation system. Both also have the capability to identify multiple poses at 20 FPS and adjustable to work with our fall detection system.

3.3.3. Fall Detection

The fall detection system uses the information from the pose estimation system to determine if a person has fallen. This system can distinguish falls from similar motions and can function with poor video quality and unusual poses.

3.3.4. Output

The output can send information to other systems for future processing, but our system only displays the number of detected falls.

4. Scenarios

4.1. Senior Care

Falls are a concern for the elderly due to their high likelihood of injury. Implementation of a fall detection system in the camera systems of hospitals and homes would allow medical personnel to react quickly to a fallen individual.

4.2. Isolated Locations

Situations where a person is alone are common, such as when they live by themselves or are walking at night. A fall sustained in this state is dangerous, since seeking immediate help is possibly difficult for many reasons. Security cameras installed with fall detection would improve the safety of the community by automatically contacting emergency services. Such a system is also affordable if the area or house already has such surveillance systems.

5. Analysis

5.1. Summary of Proposed Improvements

Our system builds on the work of previous researchers to the capabilities of the fall-detection program. This project seeks to allow the system to detect falls regardless of body position, distinguish falls from similar actions, and function properly when given noisy video inputs.

5.2. Disadvantages and Limitations

It is difficult to run the code provided by previous authors, so testing various methods is time-consuming. Another issue is that our group may not have the necessary hardware to run the fall-detection system.

5.3. Alternatives

An alternative to fall-detection software is for humans to monitor the cameras or set up patrols around an area. Such an approach is expensive, unscalable, and prone to error.

5.4. Impact

Privacy is a possible concern of the public as our system would encourage the use of cameras in the community. As a result, companies would likely attempt to collect information and breach people's privacy.

Another possible impact is the false sense of security that would arise from our program. There is the possibility of our system failing, and excessive trust in it would encourage some people to take more risks. Unless redundancies are put in place, future fall-detection systems may lead to more injuries.