NFL Players Fall Detection

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Computer vision is now widely used in different applications. It can not only recognize images but also has been used for sounds and videos detection. In this work, we propose a system that can analyze video and implements crash detection on NFL players during the game. This system detects each player's movement and tells which body part taking the hit first when falls to the ground and colliding with other players. We use segmentation method to isolate multiple players body from other objects and extract the body linkage. Later, this information will be use for fall detection.

1. INTRODUCTION

1.1. Background

National Football League (NFL) is one of the most famous sports in America. This sport consists a lot of body contacts which leads to injuries. A recent research conducted by [2] founds that from the former NFL they studied, 91.7 percents of them are diagnosed Chronic Traumatic Encephalopathy (CTE). CTE is a type of brain injury which is induced by repetitive head impacts, happening mostly on contact sports athletes [1]. In a long term, CTE will get worse and can lead to dementia [1]. With the growth of computer vision development and its application, we can utilize it for analyzing the impact felt on sportsmen. Our work will detect and give the information of the collision detected from the moving objects (players) by implementing segmentation method to extract and disclose the orientation of the body parts on each players.

1.2. Existing Researches

As there are multiple objects captured in a single image, a segmentation is needed to isolate the object, players in this case, that wants to be observed from the surroundings. The region of the extracted object is in a shape of the human itself which implicitly tells the body parts and their pose or movements. [4] has developed a segmentation technique which can detect the human body parts, size, and orientation. The key idea is they extract the silhouettes then do body parts estimation (Figure1). They use five body points which are the top of head, tip of hands, and tip of toes. In 2017, [6] built a neural network for human pose detection. In the later research, [3] incorporates segmentation with deep learning method by combining basic points estimator and object detector for multi-person pose detection which is shown in Figure 2.

Another application has been implemented by [5]. They use human posture to study the pose when human falls using cognition method. [5] separates human body into two parts which are upper and lower part. The upper part has an important information at the time of fall. By grouping into these two parts, it is able to deal with the variation of human pose and orientation. [7] uses a different approach where they utilizes the neural network to generalize those variations.

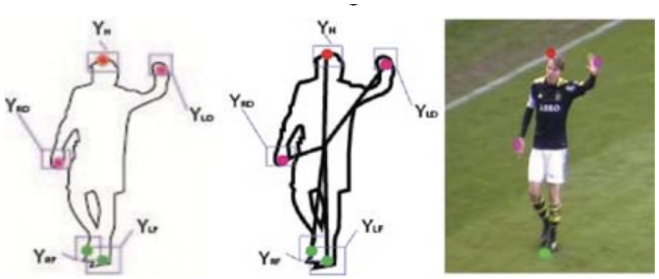

Fig. 1. Human body part model [4]

Fig. 2. Multi-person human pose [3]

2. METHODOLOGY

As the purpose is extracting information from video as an input, each frame will be extracted and converted into series of grayscale images. We simplify our model a bit, that is we think of human movement as rigid motions of mechanical linkages, with joints as pivot. Figure 3 presents several examples illustrating our model. In order to detect multiple objects in a single image, we borrow [3]'s algorithm where bounding boxes and body points are generated beforehand. In the subsequent process, the full body pose is learned based on these body points information within each bounding boxes.

Following the human pose detection, we want to determine

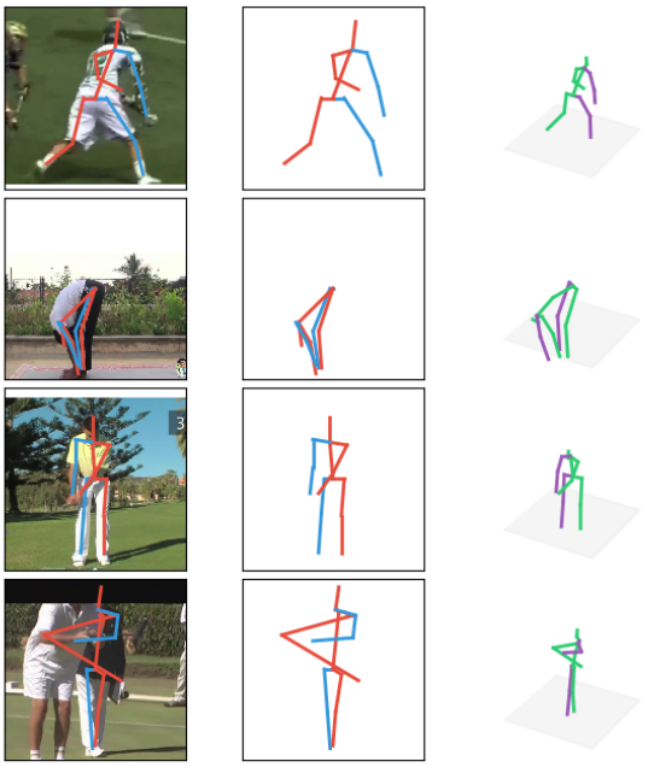

Fig. 3. Multi-person human pose [6]

if which body parts that fall first or first collided with other players. Our main approach is that we focus on feature engineering. These feature engineering process requires a learning dataset. We use Multiple Cameras Fall Dataset (MCDF) and High Quality Fall Simulation Dataset (HQFSD) which give different scenarios of falling. Using these datasets as references, we incorporating Histogram Oriented Gradient (HOG) and SVM model which enables our model to learn without using deep learning method. In addition, we will compare this method to an alternative feature extractions that uses Scale-invariant Feature Transform (SIFT). If it works well, we may consider the alternative direction with the power of neural network as shown by [7]. Note that this method could change as there might be unexpected problem that we might face or more efficient method that we could generate along the way.

3. DATASET

In order to minimize pre-processing images, we use high quality video, minimizing noise, which can be accessed in https://www.youtube.com/watch?v=jQ1l5zenaKY&ab_channel=NFL. We will not use the full length video because it is two hours duration which can be problematic during the training process as it requires a lot of times to compute. Instead, we take a small set of it for learning.

4. TIMELINE

In the first week, during spring break, each of us will spend time to read papers related to this project. Most of them are listed in the references section. By the end of the spring break, we will be able to fully understand the process of past developments and be able to select them that suit the most to our objectives. We expect that we are able to detect each player's body parts and orientation before interim report at April 7 2023. During this period, we might work on assignment 2 in parallel with the project which we think that this timeline is quite feasible. Then, we have 1.5 weeks to figure out how to implement fall detection. The remaining time will be spend to refine our code, do final check, and create documentation in a form of report.

ACKNOWLEDGEMENT

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