

The Shot Predictor

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1. Problem Description

In basketball, the ability of a player to effectively shoot the basketball typically comes down to the player's shooting form. While the form of the best shooters tend to look different, they all typically use the same fundamentals. In our project, we will attempt to capture these fundamental aspects of a player's shooting form and attempt to predict the outcome of a shot using these features. Research has been done on extracting features from a player's movement to classify the action a player is performing (shooting, dribbling, etc.) [1], but we would like to focus our energy on feature extraction from the shooting motion using pose estimation [2], object detection [3], and possibly other methods to extract feature descriptors of a shot and attempt to identify it as a make or a miss.

This problem is a particularly nontrivial application of pose estimation for two main reasons. The first being that there are multiple stages to a basketball shot that need to be taken into account. From dipping the ball to waist level, to the motion of bringing the ball to eye level, to releasing the ball, each plays a significant role in the outcome of a shot, so each stage needs to be taken into account. The second reason is the variability of the average shot. It can be argued that no two shots are identical, when taking into account the speed of the shot and different shooting forms. This will require us to develop a method of capturing all the motions of a shot in a way that is invariant to the shot's speed and overall form.

2. Related Works

2.1. Pose Estimation

Pose Estimation is a critical topic in computer vision that will intersect with our goal of trying to accurately capture the motion and actions of a person taking a shot in basketball. Pose estimation, in the context of 2D videos of humans, is the problem of localizing anatomical keypoints or

joints in a frame by frame video or image [2]. To fulfill our goal of predicting the outcome of a basketball shot, it will be critical to assess the form of a player who's taking a shot - where form can be decomposed into various classifications of joints in space. Pose estimation methods can be categorized into bottom-up or top-down methodologies. Bottom-up methodologies start by estimating keypoints and body joints first, and then these points are clustered to form poses. In contrast, top-down methodologies of pose estimation first run a person detector before decomposing each person into their respective body joints within detected bounding boxes [10]. Computational complexity is a major consideration for landmark pose estimation algorithms, and modern SOTA pose estimation algorithms deploy deep learning and CNNs to improve computational overhead and speed [2]. We list some examples of prevalent and SOTA pose estimation models that have been employed and researched below.

OpenPose: The first multi-person realtime 2D pose estimation system that uses a bottom-up approach that implements nonparametric representation to associate human keypoints and body parts with an individual in an image [2].

DeepPose: SOTA pose estimation method that uses DNNs to classify human body joints through the usage of cascading DNN regressors that produce high precision pose estimates [4].

AlphaPose: Multi-person SOTA realtime pose estimation system that outperforms OpenPose in AP score and has a high mAP score [9].

DeepCut: Proposes an approach to solving issues in both pose estimation and detection by using a partitioning and labeling formulation of a set of CNN part detectors [11].

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Method	Frobnability
Theirs	Frumpy
Yours	Frobbly
Ours	Makes one's heart Frob

Table 1. Results. Ours is better.

`\cref{...}`

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References

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