Red Light, Green Light Game

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Computer Vision Project

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1 Problem Statement

In this project, I am building a game called *Red Light, Green Light*. In the Red Light, Green Light game, players must stop moving when the 'red light' is called, and any movement during this time should result in their elimination. The problem is to create a robust and scalable computer vision solution that can track multiple players' movements in real-time, reliably distinguishing between large and small motions, and adapting to various environmental factors. The goal is to ensure that the system can enforce the game's rules fairly, providing an engaging and immersive experience for players.

2 Motivation For The Project

In a physical Red Light, Green Light game, detecting movement accurately is difficult, and human referees may make mistakes. A computer vision-based solution can automate the process, ensuring fairness by precisely determining when a player moves, thus minimizing human error. With computer vision, the system can precisely monitor player movements, ensuring that the rules of the game are strictly followed. It's more challenging for players to cheat when a sophisticated motion detection system is tracking their every move.

3 Related Works and Limitations

The challenge in building a digital version of this game using computer vision lies in accurately detecting and interpreting player movements in real-time. Current systems struggle with false positives (incorrectly identifying movement) and false negatives (failing to detect subtle movement), especially in varying lighting conditions or with different player poses and backgrounds. Additionally, the system faces difficulty when detecting multiple players in motion. This could lead to unfair or inaccurate gameplay experiences, affecting the user experience.

4 Databases (Tentative)

I plan to use the following datasets:

- Kaggle Action Recognition and Pose Estimation Datasets.
- COCO Dataset for pose detection and segmentation.

5 Algorithms & Work Plan (Tentative)

- **Human Detection:** Using the Histogram of Oriented Gradients (HOG) Human Descriptor. HOG can be used to identify and locate human figures in the game environment, ensuring that only human players' movements are considered while ignoring other moving objects, such as animals or shadows. This will reduce false positives and improve the accuracy of the movement tracking.
- **Motion Detection Algorithm:** Frame differencing to detect motion. After converting the video frames to grayscale, applying Gaussian blur to reduce noise, the absolute difference between consecutive frames can be computed. Motion is detected when significant pixel differences are found after applying a threshold and contour detection.
- **Countdown Timer and Win Detection:** A countdown timer will be implemented using the system clock, and the game will determine if the player wins by reaching the end without being detected when the light is red.
- **Convolutional Neural Networks (CNNs) and LSTMs:** CNNs combined with Long Short-Term Memory (LSTM) networks can be used to classify player actions (e.g., running, sneaking, stopping) based on sequences of frames. This will improve the system's ability to detect and classify different types of player movements.

6 Output

The expected output is a fully functioning game software where players' movements are monitored using computer vision, ensuring fair and accurate gameplay in Red Light, Green Light.