REHABILITATION PORTAL

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Abstract

The outbreak of coronavirus across the world has helped us understand the requirement of a system where proper physiotherapy sessions can be provided to patients without physically visiting them. Creating such systems would help with practicing the sessions regularly even if the patient or therapist is not in the same city. To tackle the above-mentioned issues, different technologies like video processing from the domain of computer vision can be used where the patient's videos can be evaluated based on deep learning algorithms without the physical supervision of physiotherapist. The project focuses on a set of exercises that can help people with various orthopaedic pain. The system run various different algorithms to identify the patients exercise successfully using pre-recorded videos.

Introduction

Nowadays, undergoing physiotherapy at home is extremely common. It's especially effective when the patient's health is critical or when getting to a physiotherapy clinic is impossible. For the proper supervision, normally a therapist would visit the patient's home. But in the past year, the outbreak of coronavirus across the world has helped us understand the requirement of a system where proper physiotherapy sessions can be provided to patients without physically visiting them. Creating such systems would help with practicing the sessions regularly even if the patient or therapist is not in the same city. To tackle the above-mentioned issues, different technologies like video processing from the domain of computer vision can be used where the patient's videos can be evaluated based on deep learning algorithms without the physical supervision of a physiotherapist. In this project, we are focusing majorly on the Sports based injuries and their rehabilitation exercises.

The project focuses on analysing different exercises and creating efficient deep learning models for maximum accuracy and test the videos from the external source against those models.

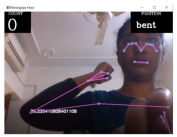

Figure 1. Webcam Feed Implementation

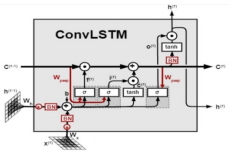

Figure 2. ConvLSTM Model.

Solution Approach

The project focuses on creating progress report for classifying different exercises and finding model with the maximum accuracy and testing videos uploaded from external source against the most accurate model. Firstly, the exercise videos are divided into small image frames and stored. These frames are then recognised into classes (standing, sitting, bending) and the correct exercise is classified through the sequence of the movements. The two models that the project focuses on are: CNN+LSTM and LRCN model. Testing is done on the model with maximum accuracy.

The desired dataset was uploaded to the notebook. The project dataset includes different short videos for around 50 different activities. Each activity contains about 20-30 videos. We load the dataset and define a function to extract a frame after every kth second. 'k' is a number calculated by dividing the video length with the sequence number. The extracted frames are then passed into the deep learning models. The models are trained and accuracy is calculated. The trained model is saved to avoid training model in every run. The model with maximum accuracy is selected and testing is performed on that model. For testing, random videos from YouTube were selected. The extracted frames help in identifying the different postures in the exercise like-standing, bending etc. The exercise type is identified by matching the sequence of these postures.

Modules/Functions

- Pre-Processing Data and Extracting Frames: Image height and width have been set up and every k frame of the video has been extracted.
- Dataset Creation: Dataset with the extracted frames is created.
- Dataset Splitting: Splitting the dataset into test and train.
- Model Creation: Functions for model creation are defined, structure of the model displayed and training the model.
- Accuracy and Plots: Accuracy for the models is displayed and the plots for total loss and total validation.
- Testing Model: The testing video is uploaded and the model with maximum accuracy is tested.

Results

Through this project, we found that the LRCN model is not just more accurate than ConvLSTM model but also takes much less computation time.

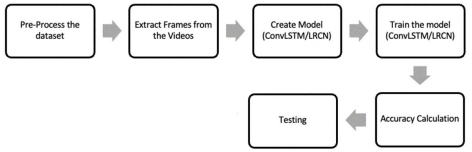

Chart 1. Flowchart for the Project.

Discussion

Limitations of the current module:

- The project doesn't provide a user interface, so only one user can use the functionality at a particular time
- For more accurate results, a larger dataset with videos from many different people would be critical
- The project doesn't have an efficient way of extracting most important frames. The frame extraction takes place based on a constant 'k' which has been selected by the developer

Our aim for this project is more than this one module:

- Create an UI interface for the user so that they can live videos can be used as testing data and multiple useability is also possible.
- Introduce sensor (Microsoft Kinect) to better train the application and improve performance of the application.
- Add Voice feature for ease-of-use.

Conclusions

During the course of the research for this project, we found that home physiotherapy hasn't been effective for many people. Upon further research, major cause of this ineffectiveness was no proper guidance for the therapy sessions. So, we decided to construct an application which detects and classifies exercises and further connect them with a doctor who can regularly monitor their progress. In this module of the project, we have designed the first aspect, to classify these exercises and test them using deep learning models.

Home physiotherapy is quite effective and essential approach to incorporate exercising in their daily routine. They can themselves keep a track of how correctly they are doing the exercises. The different models have been used for better analysis of the results and provide a better and clearer picture in identifying and classifying these exercises.

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