Using Opti Track Motion Capture in Physiotherapy

December 3, 2023

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1. **Introduction:** In recent years, the integration of advanced technology in healthcare and sports science has opened new frontiers in the diagnosis, treatment, and prevention of injuries. Among various injuries, those related to the knee are particularly familiar between athletes and can negatively affect the athlete either in his career or in his daily life. This project aims to enhance the accuracy of knee detection and provide a more analysis of knee function. In addition, it provides you with a customized program for healing. The goal is to identify movement patterns and anomalies that are indicative of knee injuries, thereby assisting healthcare professionals in their diagnostic processes.

2. **Implementation**: The implementation of this project involved a systematic process utilizing the Motive application in conjunction with the OptiTrack motion capture system. The aim was to establish a reliable and accurate setup for capturing and analyzing human knee movements.

2.1. Calibration and Environment Setup

Calibration with Calibration Wand: The initial step was calibrating the OptiTrack system to guarantee accurate tracking. A calibration wand was used to achieve this, which was waved in front of the cameras to help the system understand the 3D space.

Ground Plane Definition: A triangle with markers was used to specify the ground floor to capture all the movements relative to the ground. Ground reference is crucial for any movements like walking, running, or doing any exercise.

Camera Setup: Twelve OptiTrack cameras were positioned around the capture area to ensure a comprehensive capture of all movements without occlusions.

2.2. Suit and Marker Setup:

Suit Preparation: A colleague was equipped with a suit designed for motion capture. This suit had attachment points for the placement of markers.

Marker Placement: Reflective markers were placed on the suit with respect to the template in the Motive application called 'Baseline and Hinged Toe'. This template was chosen because it shows every muscle group in coordination and symmetrical.

2.3. Marker Detection:

Marker Recognition: The Opti Track system's cameras were configured to recognize the markers accurately if they match the selected template.

2.4. Data Capture and Initial Processing:

Motion Capture: The subject, wearing the suit, performed a series of movements. These movements were designed to stimulate common motions that could indicate knee functionality or injury such as bending his injured knee compared to the other normal knee.

Data Recording: Motive application recorded the 3D coordinates of each marker throughout the movements.

3. Evaluation Experimental Procedure and Analysis of Results

This section of the project report details the methodology used to evaluate the effectiveness of the OptiTrack motion capture system in detecting knee injuries, along with the analysis of the results obtained from the experimental procedures.

3.1. Participant Selection

Participants were selected according to some criteria, including a range of ages. Ages range is from 21 years old. Participants were divided into injured and normal ones to create a diversity sample for analysis.

3.2. Motion Capture Session

Participants performed a series of standardized movements (such as walking, squatting, and jumping) within the boundaries of the Opti Track. These movements were chosen to emphasize knee motion and potential areas of injury.

The OptiTrack system on Motive application was calibrated and aligned as previously described, captured the motion data in real-time.

4. Analysis of Results

The analysis provided insights into how knee injuries might alter movement patterns. For instance, reduced range of motion or different compensatory movements in the injured knee.

4.1. Data Processing

The captured data, consisting of the 3D coordinates of each marker relative to the cameras of the Opti Track, was processed using the Motive application. This included filtering for noise reduction.

4.2. Kinematic Analysis

Joint angles around the knee, were calculated and analyzed. The focus was on identifying irregular patterns in knee movement that could indicate potential injuries.

4.3. Comparative Analysis

There was a comparison between data of known knee injuries and of normal participants with no knee injury. The aim was to detect distinct differences of movement patterns that could indicate knee injury.

5. Societal impact of project including legal and ethical considerations

5.1. Enhanced Injury Detection and Rehabilitation

The main goal for this project is to improve knee injury detection, which makes individuals' quality of life better, especially with athletes and elderly people.

5.2. Healthcare Efficiency

Accuracy and early diagnosis can reduce the time and resources currently needed for diagnosis.

5.3. Consent and Ethical Use of Data

Informed consent must be obtained from all participants, clearly explaining how their data will be used and if they are okay with sharing their data for medical purposes. Transparency about the capabilities and limitations of the technology is also crucial.

6. Ethical Use of Data

6.1. Transparency in Data Usage

Maintain transparency about how the data is being used. We should have the participants consent if their data is being used solely for the purpose of this project or if it might be used in future projects.

6.2. No Unintended Use

Ensure that the data is not used in anything other than what was originally intended without explicit consent from the participants.

7. Conclusion

The project contributes to the field of healthcare by providing a new approach to knee injury detection, potentially enhancing diagnostic accuracy and patient outcomes. It focuses on effectual comparison of motion patterns between injured and non-injured knees, highlighting potential indicators of knee injuries. Besides this, it highlights the importance of ethical considerations and legal compliance in healthcare technology, particularly in the context of data security and privacy. In addition, future extensions to other types of joint injuries, which could further validate the utility of the technology.