

# Sit to Stand Testing

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## Introduction and Aims

- The aim of this project was to develop a program that could be used to analyse a one-minute sit to stand test using a webcam or a pre-recorded video.
- The performance of the program should be fast enough to allow for real time analysis of the test.
- The program should have rudimentary file sorting capabilities to allow for the performance of a pilot study on subjects in the future.

## Program Functionality

For this project it was decided that the following functions were needed in the program:

- a. Track points on the human body, known as "Landmarks".
- b. Use the Landmark Data to find how much each leg and hip is bending.
- c. Graph the bend data over time and save the raw data to an excel spreadsheet.
- d. Count each Sit to Stand movement and time the test automatically.
- e. Build the program into an executable (.exe) file so that it can run on any Windows Computer.

Python was chosen as the language to program in due to the wealth of open-source computer vision and data collection libraries available for it.

OpenCV-python was used for pose detection and Landmark Tracking.

Matplotlib was used for graphing the angle data.

Pandas was used for generating the excel datasheets.

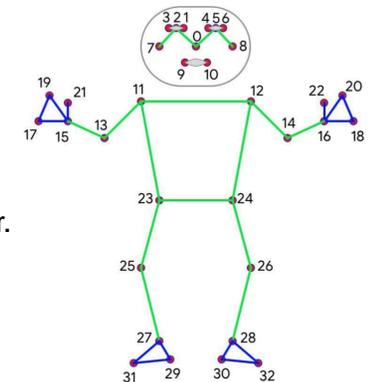


Figure 2: Diagram of the pose tracking landmarks provided by the OpenCV-python library

## Background: What is a Sit to Stand Test?

A sit to stand test is a test where a patient will sit down and stand up from a chair for a set amount of repetitions or for a set amount of time. The test was first designed to measure the leg strength of older people [1] but can also be used as an indicator of muscle endurance in a larger age range when using the one-minute Sit to Stand test.[2]



Figure 1: A sit to stand test being performed

## Data Generation

The pixel coordinates of landmarks 11, 12, 23, 24, 25, 26, 27, and 28 from the landmark map in Figure 2 would be recorded by the program on a frame-by-frame basis.

A function was written to take three landmarks and used the following formula to calculate the bend angle of each leg and each hip in radians using the pixel coordinates of those landmarks:

$$\arctan\left(\frac{y_3 - y_2}{x_3 - x_2}\right) - \arctan\left(\frac{y_1 - y_2}{x_1 - x_2}\right)$$

Where the angle is then converted to degrees by the program before being recorded and displayed.

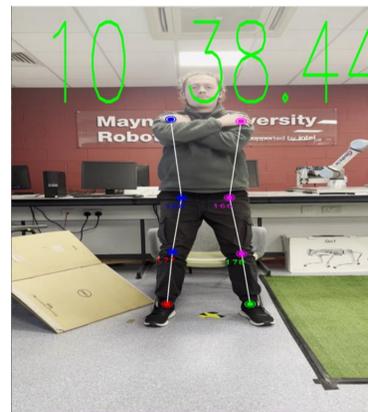


Figure 3: The program mid test

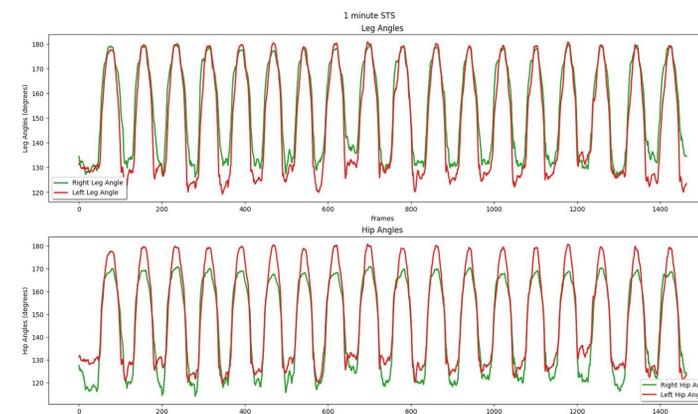


Figure 4: Graph of leg and hip angles from a one-minute test

## Conclusion

The program was successful in highlighting imbalances between each side of a subject performing a 1-minute sit-to-stand test that were imperceptible to the human eye. It facilitates remote performance of the test allowing a subject to send a video of them performing the test to their physician and provides a realtime aid to physician administering the test.

## Acknowledgements

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