Considerations for Applying MediaPipe to Gait Analysis

Comparison with commercial software

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Biography

In 1987, he received a doctor of engineering from the Tokyo Institute of Technology for research on speeding up amorphous silicon thin film transistors.

From 1980 to 1987, he worked at Tokyo Institute of Technology as a research associate in the Department of Electronic and Physical Engineering, and from 1987 to 1990 as a research associate in the Faculty of Engineering, Takushoku University. 1990 to 1990, he worked at West Tokyo University of Science (now Teikyo University of Science) as an associate professor. 2007 to 2012, Department of Media Information Systems, Department of Life Sciences, he has worked as a professor.

Currently working on health status change detection using insole sensors, video analysis and machine learning.



Topics of research interest of our group

Our research group is in charge of creating a health management system that applies various sensing technologies in a group that conducts joint research with occupational therapists and physical therapists working in hospitals.

Specifically, we are developing technology to detect signs of physical condition changes by analyzing data from wearable sensors such as smart insoles and acceleration sensors, as well as image.

INTRODUCTION

The WHO's website on the elderly states the following

Ageing presents both challenges and opportunities. It will increase demand for primary health care and long-term care, require a larger and better trained workforce, intensify the need for physical and social environments to be made more age-friendly, and call for everyone in every sector to combat ageism.

https://www.who.int/health-topics/ageing#tab=tab_3

Population developments, by age class, EU-27, 2001-2050 (million inhabitants)



marks the divide between official historical data and EUROPOP2019 population projections. Source: Eurostat (online data codes: demo pjangroup and proj_19np)

> https://ec.europa.eu/eurostat/statisticsexplained/images/thumb/d/dc/Population developme

Asian ageing: The relationship between the elderly population and economic growth in the Asian context





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Keep on Your Feet—Preventing Older Adult Falls

Print

Falls are common and costly, especially among Americans age 65 and older. But falls are preventable and do not have to be an inevitable part of aging.

Every second of every day, an older adult (age 65+) suffers a fall in the U.S.—making falls the leading cause of injury and injury death in this age group. <u>One out of four older</u> <u>adults</u> will fall each year in the United States, making falls a public health concern, particularly among the aging population.



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Hospitalization or the need for assistance in daily living

https://www.cdc.gov/in jury/features/olderadult-falls/index.html

The measurement of lower limb function is useful in assisting the prevention of falls.

Until now, therapist, such as rehabilitation and nursing care staff, have been responsible for providing support to prevent falls.

In recent years, devices for measuring lower limb function have become widespread. It will be important to establish how to use the system so that therapists and patients can easily obtain the data which they need using these devices where they need it. Previous work

At Global Health 2022, we presented a basic application of MediaPipe in the field of rehabilitation.

In addition, we reported that when a walking aid was used, analysis using MediaPipe showed that the effect persisted for approximately 5 minutes after the walking aid was removed. We also reported the results of an additional study on the accuracy and coverage of gait parameters obtained using MediaPipe. Y. Uchida, et. al., International J. of Advances in Life science, vol.15, no 1&2,

Y. Uchida, et. al., International J. of Advances in Life science, vol.15, no 1&2, 2023, pp. 45-55.

Aim of this study

we will show the results of analysis using images taken from angles that are considered to have a wider range of applications, as well as the results of a comparison with commercial analysis software.

*This research was approved by the Ethics Committee of Teikyo University of Science.

*There are no conflicts of interest regarding this study.

EXPERIMENTAL

MediaPipe

Features of MediaPipe

- Free software
- Get to CSV data from

33points:

Using the pose landmark model, we can obtain 3-axis coordinate datacorresponding to the x, y, and z axes.

• The image of the skeleton is shown projected onto the subject.

Pose Landmark Model of Media pipe



https://google.github.io/mediapipe/solutions/pose



The participant was a male in his 60s.

During the measurement, his right knee was fixed with a supporter to pseudo-restrict his movement.

The angle θ of the ankle was calculated from the inner product of two vectors as shown in the figure.

$$\theta = \cos^{-1} \frac{\vec{a} \cdot \vec{b}}{|\vec{a}| |\vec{b}|}$$

No restriction

Restriction

Examples of measurements using MediaPipe. The image on the left shows measurement without motion restriction, and that on the right shows that with motion restriction.

ORPHE ANALYTICS & CORE

To enable analysis using ORPHE ANALYTICS, we used an iPhone with ORPHE TRAC installed to receive acceleration signals from ORPHE CORE[®] via Bluetooth; simultaneously, the data of the walking state were uploaded to the cloud service.



A comparison was made using the tool ORPHE ANALYTICS[®] to confirm the accuracy of the calculation results obtained from the 3D coordinate data obtained using MediaPipe.





Ankle trajectory for some viewing angles



It looks like the enclosed parts are different.

Z-axis values for walking when approaching the camera

Only one round trip was used in the analysis.



ther angle

0.6

0.5

0.4

0.3 Z

0.2

0,1

It is difficult to find an angle that can be evaluated accurately.



For each step, the average walking speed was determined by calculating the distance and landing time from the video screen as a reference.



In the MediaPipe, the stride length was 0.8–0.9 m, and the velocity obtained was 0.8 m/s. The stride lengths of the left and right legs were 0.7 and 0.8 m, respectively. These results were almost same those obtained from ORPHE ANALYTICS.

Comparison of knee height changes obtained from MediaPipe and ORPHE ANALYTICS

MediaPipe



Almost identical trends were obtained.

ORPHE ANALYTICS



* In ORPHE ANALYTICS, the origin is the upper left corner of the screen, and the largest y-axis corresponding to the vertical direction is represented by 352 pixels.

Euler angle shown in ORPHE ANALYTICS display





Displays Euler angles in the x- and y-axis directions



In ORPHE ANALYTICS, we used the Euler angle in the x-axis direction as the ankle angle.

Shoe display direction changes according to the direction of walking and the angle of the ankle

Comparison of ankle angles evaluated by MediaPie and ORPHE ANALYTICS



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CONCLUSIONS

The values obtained through calculation from MediaPipe, which can display skeletal certification, were compared with those of commercially available gait measurement systems to investigate the differences.

(1) The study revealed that the effects of different angles of video recording during gait should be considered in programming and in determining the results obtained with MediaPipe.

(2) MediaPipe can be an effective tool for determining walking conditions when the cost of implementing the system and the data required are limited.

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