स्वामी विवेकानन्द योग अनुसंधान संस्थान

Swami Vivekananda Yoga Anusandhāna Samsthāna

(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956)

Eknath Bhavan, # 19, Gavipuram Circle, Kempegowda Nagar, Bangalore - 560 019

Ph: 080 - 2661 2669, Telefax: 080 - 2660 8645

E-mail: svyasa@svyasa.org Website: www.svyasa.org

Certificate

This is to Certify that the Doctoral Committee confirms that this is an authentic approved copy of the thesis titled **"Bio- Mechanics of Yogasanas : A Study of Alignment and Proficiency " submitted by Mohan Kishore. D bearing Registration No. 1110819004.**

The Viva-voce examination was conducted on **Wednesday, 09th November 2022** through online google meet with session link: meet.google.com/iqc-awwv-giu

The committee recommends the award of the PhD Degree.

Dr. Subodh Kumar Panda
National Reviewer & Examiner
Associate Professor,
B N M Institute of Technology
Bengaluru.

Dr. Sanjay Chahar,
International Reviewer & Examiner
IGMM, CNRS,
University of Montpellier, France.

Dr. Manjunath N. K
Guide & Director of Research,
Pro- Vice- Chancellor
S-VYASA, Bengaluru

Prof. Ramesh Mavathur
Dean of Academics
S-VYASA, Bengaluru

Dr. Sony Kumari
Registrar - Evaluation
S-VYASA, Bengaluru

Prof. S. Siva Shankar Sai
Registrar
S-VYASA, Bengaluru

Dr. B. R. Ramakrishna
Vice-Chancellor
S-VYASA, Bengaluru

CERTIFICATE

This is to certify that **Mohan Kishore D** who has been given Ph.D. registration **1110819004** with effect from August 2019 by Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), is deemed to-be-University under the Division of Yoga and Life Science has successfully completed the required 'training' in acquiring the relevant background knowledge and has completed the 'course of research' for not less than two years to submit this thesis entitled **"Bio-Mechanics of Yogasanas - A study of Alignment and Proficiency"** as per the regulations of the University.

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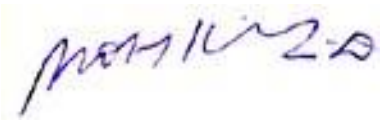
Dr. Manjunath N K
(GUIDE)

DECLARATION

I, hereby declare that this study was conducted by me at Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), Bengaluru, under the guidance of research supervisors **Dr. Manjunath N K**, Division of Yoga and Life Sciences at S-VYASA Deemed-to-be University, Bengaluru.

I also declare that the subject matter of my thesis entitled "**Bio-Mechanics of Yogasanas- A study of Alignment and Proficiency"**, has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or similar titles.



Mohan Kishore D

Dr. Manjunath N K
(GUIDE)

Date: 09th November, 2022

Place: Bengaluru

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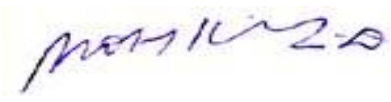

Date: 09th November, 2022 **Mohan Kishore D**

Place: Bengaluru

STANDARD INTERNATIONAL TRANSLITERATION CODE USED TO TRANSLITERATE *SAṀSKṚTA* WORDS					
a	अ	*gha*	घ	*pa*	प
ā	आ	*ṅa*	ङ	*pha*	फ
i	इ	*ca*	च	*ba*	ब
ī	ई	*cha*	छ	*bha*	भ
u	उ	*ja*	ज	*ma*	म
ū	ऊ	*jha*	झ	*ya*	य
ṛ	ऋ	*ña*	ञ	*ra*	र
ṝ	ॠ	*ṭa*	ट	*la*	ल
e	ए	*ṭha*	ठ	*va*	व
ai	ऐ	*ḍa*	ड	*śa*	श
o	ओ	*ḍha*	ढ	*ṣa*	ष
au	औ	*ṇa*	ण	*sa*	स
aṁ	अं	*ta*	त	*ha*	ह
aḥ	अः	*tha*	थ	*la*	ळ
ka	क	*da*	द	*kṣa*	क्ष
kha	ख	*dha*	ध	jña	ज्ञ
ga	ग	*na*	न		

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ABSTRACT

BACKGROUND

Yoga is a traditional Indian way of keeping the mind and body fit, through physical postures *(asanas),* voluntarily regulated breathing *(pranayama),* meditation and relaxation techniques. The recent pandemic has seen a huge surge in the number of yoga practitioners, many practicing without proper guidance which leads to unexpected injury.

AIMS AND OBJECTIVES

The present study was designed to develop a technology-driven pose estimation method to assess and evaluate yoga postures to understand the level of accuracy. It will assist practitioners to perform any yoga posture with the support of a machine learning algorithm.

METHODS

Participants

Twenty practitioners in the age group of 18 to 60 years performing different postures in real-time were captured and fed separately to the proposed architectures and a comparison of the estimated accuracy was done.

Design

The present exploratory study included a group of 20 yoga practitioners to assess the accuracy and proficiency of yoga postures.

Assessments:

The image of a yoga practitioner performing an *asāna* is captured by a camera and fed separately to the four deep learning architectures, which then estimate the pose performed by the practitioner by comparing it with the pre-trained model. An error is shown if it does not match any of the five asanas.

Intervention:

The five yoga poses considered for posture estimation are

(a) *Ardhacandrāsana* (Half-moon pose)

(b) *Tāḍāsana* (Mountain pose)

(c) *Trikoṇāsana* (Triangular pose)

(d) *Vīrabhadrāsana* (Warrior pose-II)

(e) *Vṛkṣāsana* (Tree pose)

Results:

In this work, four distinct deep learning architectures-Epipolarpose, Openpose, Posenet, and Mediapipe-were utilized to evaluate yoga postures. The results show that, despite only utilising one camera, Mediapipe outperforms the other approaches in terms of accuracy. Five yoga postures have had their poses estimated using various suggested methods. Following the model's validation, the posture correctness of 20 real-time sample photos was estimated using the model.

Conclusions:

The health and fitness industry can employ human pose estimation efficiently. The huge range of poses with high degrees of freedom, the occlusions caused by the body or other objects blocking limbs as viewed from the camera, and the wide range of appearances or clothes make pose assessment for fitness applications particularly difficult. The mediapipe design offers the best estimation accuracy, according to this study, which evaluates the estimation of five different postures.