A Study of Vision based Human Motion Recognition and Analysis

Geetanjali Vinayak Kale, MCOERC, SPPU, Pune, India
Varsha Hemant Patil, MCOERC, SPPU, Pune, India

ABSTRACT

Vision based human motion recognition has fascinated many researchers due to its critical challenges and a variety of applications. The applications range from simple gesture recognition to complicated behaviour understanding in surveillance system. This leads to major development in the techniques related to human motion representation and recognition. This paper discusses applications, general framework of human motion recognition, and the details of each of its components. The paper emphasizes on human motion representation and the recognition methods along with their advantages and disadvantages. This study also discusses the selected literature, popular datasets, and concludes with the challenges in the domain along with a future direction. The human motion recognition domain has been active for more than two decades, and has provided a large amount of literature. A bird’s eye view for new researchers in the domain is presented in the paper.

KEYWORDS

Human Motion Analysis, Human Motion Representation, Human Motion Recognition, Recognition Methods

1. INTRODUCTION

Vision based human motion recognition is a systematic approach to understand and analyse the movement of people in camera captured content. It comprises of fields such as Biomechanics, Machine Vision, Image Processing, Artificial Intelligence and Pattern Recognition. It is an interdisciplinary challenging field having grand applications with social, commercial, and educational benefits. A wide spectrum of applications demands human motion recognition. The applications are spread over domains like sports, medical, surveillance, content based video storage and retrieval, man-machine interfaces, video conferencing, art and entertainment, and robotics (Aggarwal & Nandkumar, 1988; Aggarwal & Cai, 1999; Aggarwal & Ryoo, 2011; Gavrila, 1999; Poppe, 2007; Turaga et.al, 2008). Some of the applications for highlighting the potential impact of human motion recognition are discussed here.

• Smart Surveillance: In today’s surveillance systems, video contents are viewed continuously by human operators. With the increasing number of cameras, it is impossible for humans to monitor all the contents 24 X 7. Generally, the contents are viewed after a mishap to analyse the event. So, there is an intense requirement of smart surveillance systems from the security agencies. Smart surveillance systems can analyse an event online and provide appropriate intimation using computer based human motion and behavioural analysis. Smart surveillance is required for access control in special areas like military territory, distant human identification, counting the persons and congestion analysis, detection of abnormal behaviour at shopping malls, railway
stations, hospitals, government buildings, commercial premises, and schools (Makris & Ellis, 2005; Morris & Trivedi, 2008). Nowadays smart home concept is gaining attention of computer vision community to improve the quality of life of the inhabitant (Guesgen & Marsland, 2016).

- **Behavioural Biometrics:** Nowadays, the use of the gait pattern as a biometric has become popular. The main reason is that the recognition of the gait pattern does not require subject cooperation as compared to the other biometrics (Sarkar et. al 2005).

- **Gesture and Posture Recognition and Analysis:** For a more advanced natural interface with computers and computerized systems, human gesture and posture recognition is an important key. It has promising applications such as gaming, sign language recognition, controlling devices, and others (Ronchetti & Avancini, 2011; Seperi et. al, 2006).

- **Robotics:** Human motion analysis plays an important role in robotics for humanoid robot control, to imitate human motions in a robot in virtual and augmented environments (Hoffman, 2010).

- **Medical:** The medical field uses human motion recognition for the study and analysis of Orthopaedics, Neurology, Musculoskeletal disorders, body posture, and fitness. It is also useful to design intelligent systems to assist elderly people and physically / mentally disabled ones (Najafi et. al, 2003; Lin & Kulic, 2013).

- **Sports and Exercise:** In sports, motion recognition is useful to analyze athletic movements and to design affordable and efficient frameworks for training (Bertini, 2003). An environment for rehabilitation exercise with a feedback system at remote places or in the presence of an expert is designed (Watanabe 2015). Dao (2016) proposed a monitoring system for the exercises of elderly people. These kinds of systems will definitely be useful for patients and old age people.

- **Art and Entertainment:** Motion recognition is useful in analyzing, learning, and an emotional understanding of artistic dance movements as in dances like Bharatnatyam, and Salsa. Kale and Patil (2015) have recognized Bharatnatyam dance sequence from depth data. This also helps to increase the effectiveness of a scene, and the alteration of movements required for quality and the impact of acting.

A large variety of applications have different human motion representation and recognition techniques. Human motion analysis is very general term and application decides the number of body parts involved and duration of movement. Human-computer interaction generally involves only hand gestures, whereas, complicated activity or applications like sports, dance may involve all body parts. Depending on complexity, human motion is conceptually categorized into gestures, actions, activity, interactions, and group activities. Representation and recognition methodologies are decided from tracking and initialization of human body in video. Broad approaches for representation are 2-D Kinematic or stick figure, 3-D kinematic or shape model and image model. Initialization of human using Kinematic method represents human by features like number of joints, its degree of freedom, limb length etc. Whereas, in image model human is represented as image itself and features like shape or region are extracted and stored. Further the recognition can be decided from representation as well as complexity of the motion. Simple actions use sequential or space time single layered approaches. Complicated action requires multi layered approaches. Detailed discussion of recognition methods is given in section 3.4. Even though vision based human motion recognition and analysis has made a much progress, but still it is far away from becoming an off-the-shelf technology. Challenges like occlusion, shadows, lightning, and in-class variance need to be addressed. The remaining paper is organized in to five sections: section 2 discusses the reported literature in the domain, section 3 discusses the human motion recognition framework in detail, a brief discussion on the available datasets is given in section 4, and the paper is concluded with a rigorous discussion in section 5.
Query Expansion Using Medical Information Extraction for Improving Information Retrieval in French Medical Domain
www.igi-global.com/article/query-expansion-using-medical-information-extraction-for-improving-information-retrieval-in-french-medical-domain/204950?camid=4v1a

Innovative Learning Approach in the 21st Century: Personal Learning Environments
www.igi-global.com/chapter/innovative-learning-approach-in-the-21st-century/227913?camid=4v1a