Motion Capture Technology

Subjects: Others

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Motion capture (MoCap) is the process of digitally tracking and recoding the movements of objects or living beings in space.

Keywords: motion tracking ; robot control ; wearable sensors ; gait analysis ; IMU

1. Introduction

Different technologies and techniques have been developed to capture motion. Camera-based systems with infrared (IR) cameras, for example, can be used to triangulate the location of retroreflective rigid bodies attached to the targeted subject. Depth sensitive cameras, projecting light towards an object, can estimate depth based on the time delay from light emission to backscattered light detection[1]. Systems based on inertial sensors[2], electromagnetic fields[3] and potentiometers that track the relative movements of articulated structures[4] also exist. Hybrid systems combine different MoCap technologies in order to improve precision and reduce camera occlusions[5]. Research has also focused on the handling and processing of high dimensional data sets with a wide range of analysis techniques, such as machine learning[6], Kalman filters[7], hierarchical clustering[8] and more.

2. Application

Thanks to their versatility, MoCap technologies are employed in a wide range of applications. In healthcare and clinical settings, they aid in the diagnosis and treatment of physical ailments, for example, by reviewing the motor function of a patient or by comparing past recordings to see if a rehabilitation approach had the desired effect[9]. Sports applications also benefit from MoCap by breaking down the athletes' motion to analyse the efficiency of the athletic posture and make performance-enhancing modifications[10]. In industrial settings, MoCap is predominately used in the entertainment[11] and gaming industry[12], followed by relatively few industrial applications in the sectors of robotics[13], automotive[14] and construction[15].

2.1. MoCap Industrial Applications

MoCap techniques for industrial applications were primarily used for the assessment of health and safety risks in the working environment (Table 1, 64.4%), whilst fatigue and proper posture were the most targeted issues[16][17][18]. Productivity evaluation was the second most widespread application (20.3%), with studies typically aiming to identify inefficiency or alternative approaches to improve industrial processes. Similarly, MoCap techniques were also employed to directly improve workers productivity (10.1%), whereas 8.5 % of the studies focused on task monitoring[19] or in the quality control of an industrial processes[20].

Table 1. Generic MoCap applications in industry.

Applications	Study	Number of Studies	Percentage of Studies
Workers' Health and Safety	[14][15][21][22][23][24][25][26][27][28][29][30][31][32][33][34][16][17][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52][53][54]	38	64.4%
Improvement of Industrial Process or Product	[55][56][57][58][59][60][61][62][63][64]	10	17.0%

Workers' Productivity Improvement	[65][66][67][68][69][70]	6	10.1%
Machinery Monitoring and Quality Control	[19][20][71][72][73]	5	8.5%

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