

## Impact of Motion Capture Technology on Ergonomics

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### DESCRIPTION

As a scientific study that dive in to finding the relationship between human and their working environment, ergonomics is described by many scientist and researchers based on their field of professions. According to Occupational Safety and Health Administration (OSHA), reinforcing workers' knowledge in ergonomics and safety practices is extremely important in order to minimize the risk of Musculo Skeletal Disorder (MSD) among employees and increase productivity. The imminent threat in hazardous jobs (e.g., manufacturing, construction, warehousing, transportation, healthcare services, quarrying and mining) and emergency services (e.g., firefighters, law enforcement and the military) outcomes in extensive risks of occupational injuries [1].

Since most of the predominant ergonomics-related injuries among workers are musculoskeletal in nature, precisely caused by overload, repetition and an awkward posture in carrying out their jobs. Work-Related Musculoskeletal Disorder (WMSD) is a painful disorder that affects workers' musculoskeletal system (MSS). The Musculo Skeletal System (MSS) includes the bones of the skeleton, cartilage, ligaments, muscles, tendons, joints and other connective tissues that support and bind organs and tissues together. The MSS is responsible for providing shape, support, stability and locomotion to the body. WMSD is a disorder that disturbs the MSS and results to pain and disabilities [2].

Considering the calamities of ergonomics hazards in working environments, several researchers and expert are working tirelessly to tackle those calamities. Jones believed that implementation of safety ergonomics in a working environment will results a fruitful benefit. Some of these benefits includes, reducing the risk of work-related injuries and sicknesses, increasing employee commitment and loyalty, and improving the productivity. Others such as in are in the view that designing a work place for employees can improve the quality of health and improve productivity. Thus, creating ergonomics working environment for employee's wee-being and productivity is extremely important [3,4].

Motion captures technology illustrates a significant role in enhancing workplace ergonomics. As it relates to the recording of the movement of people or objects, Motion Capture (MoCap) are categorized in to three popular systems Marker-Based (MBased) Marker-Less (MLess) and Inertial Measurement Unit, (IMU) systems. All these systems have been used by different researchers to measure the ergonomic risks of workers by capturing their body kinematics using smart cameras and transforming the information into three-dimensional (3D) data. These Mocap systems can be applied to any type of working environments that is why this work aims to assist researchers, healthcare practitioners and industrial managers to identify appropriate MoCap systems in various applications of their need.

A systematic literature review on motion capture technology by Sani et al. [5] supports that Motion capture (Mocap) technology to well-being of employee, enhancing productivity the growing background of ergonomic research. Mocap techniques are used to obtain workers' data in their working environment and use such data in applying ergonomic principles to worker guidelines to reduce the risk of musculoskeletal disorder and improve productivity. Mocap systems are used to access the ergonomic condition of all human body parts and they performed accurately in both real time and laboratory environments. Mocap systems are categorized in to Marker Based (MBased) system, Marker Less (MLess) systems and Inertial Measuring Unit (IMU) systems [5].

MBased systems consist of infrared markers mounted on the body of an object to track the continuous motion of that object in 3D space. The data obtained from this system may be use to access the potential cause of a specific disorder of a given body segment and determine the impact of that disorder. MBased systems are used to improve skill acquisition and reduce physical stress during laparoscopic surgery, lead clinicians to a more specific assessment and better intervention in upper extremity rehabilitation, investigate implicit detection of speech gesture, improve skill acquisition and reduce physical stress during laparoscopic surgery, allows a quantitative assessment of lower limb motion in the sagittal plane and reduce the biomechanical

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loads experienced by emergency medical service providers when lifting and moving the patients. Popular Mbased Mocaps are Vicon V & T series, OptaTrak, OptiTrak, PhaseSpace and etc.

MLess system is a Mocap system in which no markers are attached to the body of the object when recording the data of that object. It is considered to be efficient, easy to use and demonstrated promising outcomes in occupational safety and gait analysis. MLess systems is used to detects kinematic abnormalities of the trunk during slow walking on a flat land, monitoring of Parkinson's in residential setting, tracking upper body motion, biomechanical analysis purposes and fostering operation of an aircraft fuselage. Popular MLess systems include Microsoft Kinect, OpenSim, Captive, Microsoft Kinect V2 and etc.

IMU system is device that is used to measure and describe precise angular rate and gravity of a given object that is attached to it. IMU has been used by many researchers to diagnose the biomechanical overload of manual material handling workers and analyse the motion of a healthy human wrist joint. IMU system are used to predict the deviation of knee extension angle, reduce the risk of musculoskeletal disorders in industrial settings, meet the needs of doctors for real time monitoring of patients' physiological parameters during clinical health monitoring, measure the accuracy of trunk speed during walking in transition period, perform biomechanical analysis, improve workplace design, lower the limb joint angle during straight walking, diagnose the risk of musculoskeletal disorder when doing physical activities, measure the potential health risks of working class, predict the effect of bad working place on operators, diagnose workers with lateral epicondylitis, compute joints risks for every posture and output the total risk for the assessed workstation and enhance workers' productivity Popular IMU includes Xsens, CaptivL, Oqus300 and etc. Creation of a productive, safe and satisfactory working environment is very essential for the well-being of the employee and productivity

growth. Ergonomic intervention plays a crucial role in forming a productive, safe employee-centric working place [6].

## CONCLUSION

Motion capture technology plays a vital role in creating and promoting conducive working environment. These technologies provide accurate and feasible assessments of various musculoskeletal parameters and can aid in diagnosing and monitoring conditions such as upper extremity rehabilitation, Parkinson's, back pain, joint kinematics and work-related musculoskeletal disorder. MBased system are very effective in promoting employee's well-being and safety, IMU system can be utilized in uncontrolled working environment while MBased and MLess performed best in controlled environment such as laboratory. Thus utilizing Mocap system is necessary for ergonomic intervention and increasing productivity.

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