Designing Wearable Systems for Movement Correction in Physical Therapy Applications

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Musculoskeletal injuries are the leading cause of disability worldwide [4]. Patients suffering from these disabilities are often given exercises to perform by physical therapists to strengthen muscle groups or joints that have been injured. Typically, these exercises are observed in-person at the physician's office, and the patient is instructed to continue them at home; however, challenges exist with patient adherence to these exercise regimes, with some studies showing that 37% of patients failed to continue their exercises at home [5]. Failure to complete these activities leads to longer recovery times, additional visits to the physician, and generally lower health outcomes.

To address these healthcare challenges research has been initiated at JMU to develop a wearable computing system that will provide real-time feedback to patients at home as they perform their exercises. Specifically, the system will be designed to recognize the wearer's activity, provide corrective feedback on that activity, and collect clinically relevant information for the user or a supervising physician. The system seeks to improve a patient's self-efficacy in completing their exercises and improve adherence to the exercise regime [6].

A current obstacle for the project's success is obtaining accurate pose and joint angle information upon which to make user feedback determinations. Current methods to capture body motion utilize a combination of body-worn inertial measurement units (IMUs) or cameras placed in the environment. While these approaches can be effective, they have potential drawbacks as IMUs can rapidly become inaccurate as the user moves, and camera-based methods suffer when a person is occluded within the camera viewing area. Thus, the effective development of the feedback mechanisms to correct a user's exercise is dependent upon having an accurate observation of the person's motion. This lack of accurate observations upon which to base feedback mechanisms can be resolved by evaluating prototypes in the high-resolution motion capture systems available in the Virginia Tech Cube and Perform Studios [3].

[3] "ICAT Studios." [Online]. Available: https://icat.vt.edu/studios.html

[4] "Musculoskeletal conditions." [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions

[5] R. Forkan, B. Pumper, N. Smyth, H. Wirkkala, M. A. Ciol, and A. Shumway-

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[6] K. Jack, S. M. McLean, J. K. Moffett, and E. Gardiner, “Barriers to treatment adherence in physiotherapy outpatient clinics: a systematic review,” Manual therapy, vol. 15, no. 3, pp. 220–228, 2010.