Recumbent Exercise Bicycle for Low-Impact Rehabilitation of Obese Individuals

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It is often difficult for persons who are extremely overweight to find exercise systems that are accessible and safe to use. Seating is required to handle heavier loads of up to 500 lbs. and provide safe access to the exercise unit. Additionally, the exercise should not cause additional pain or possible damage if the person needs to suddenly stop. A multidisciplinary team of undergraduate engineers participated in a training course to interview a non-technical customer to determine design requirements and then underwent a rigorous design process to implement the best solution. Mechanical analysis was performed to determine the best solution for the concept, materials, and resistance. An exercise machine with a rotating chair was selected as the best solution. The chair rotates 90 degrees so that the user can sit down without having to step onto the machine. Once the user sits, the chair can then rotate 90 degrees until the chair is in the exercise position; in either position the chair locks into position for stability. This particular concept uses a bicyle exercise. This exercise minimizes impact on the knees, which is a safety issue for patients with knee problems. A sitting position for this exercise eliminates the stability issue raised with a standing exercise, where there is worry of falling. This exercise is beneficial for cardiovascular exercise. Resistance is implemented using a magnet. Fluid resistance and fly-wheel resistance would create too much momentum which was not desired by the customer. Electrical analysis was performed to determine the best method to sense heart rate, speed, and computer interface. Wired handles were selected to monitor the heart rate. These are hand held and are much easier to use than a chest strap. An optical sensor was used to sense speed. It was placed near the center of the wheel and rotations were indicated by a tab to break the connection in the sensor. This method was selected over a Hall effect sensor because it is a much simpler sensing method that does not require an addition magnetic component that is not too accurate a low speeds. The computer interface was a Motorola HC12s since it had the necessary I/O interfaces and was low cost. A custom interface was created with seven segment displays to show the heart rate and time of exercise. The system was then developed, tested, and delivered to the customer for use. This project was supported by Grant No. 0607883 from the National Science Foundation.

Medtech Design in Interdisciplinary Clinical Innovation Teams

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Interdisciplinary settings have been highlighted for creative user-close development of products and services. Similarly, user involvement in the actual design process has been presented as a way to make attractive products that will earn market shares. But will an interdisciplinary setting in itself generate the beneficial spin-offs we expect? Will including the end-user on the development team ensure better products that are more successful on the market? A study has been set up to create a work model for Clinical Innovation Teams (CIT) at the Sister Kenny Research Center in Minneapolis, MN, to facilitate the research and development process, and provide guidance to work in a creative and innovative way around rehabilitation technology development. The CITs consist of clinicians, such as nurses, occupational therapists, physical therapists, physicians, engineers and engineering students, and in some cases patients. The CITs combine the interdisciplinary setting and end-user involvement with a custom work-model. The work-model emphasizes the strengths of the teams and provides tools to overcome the obstacles and challenges that these kind of teams face. The technological depth and clinical experience is combined with a structured project work-model. The teams work interdisciplinary by pairing research with actual patient needs to develop rehabilitation technology and medical devices to address those needs. The first tool in the work model is an Innovation Handbook for development projects at the Sister Kenny Research Center, especially written for this specific setting. The second tool is a report with recommendations to the management on how to create a work environment where innovation can occur and where creative ideas are welcome, as well as how to engage clinicians into research. The report also addresses aspects of workplace design, recommendations on how to deal with uncertainties that come when moving between clinical care and research and ideas of how to ensure quality of care and maintain productivity when clinicians engage in research activities. The third tool in the work model is a schematic illustration of how the important elements of innovation management is paired with the design process, and how a project will benefit from good management and where it will suffer from insufficient support. This project has been supported by the City of Minneapolis, the Sister Kenny Research Center and the Product Innovation Engineering Program of Sweden (PIEp). Corresponding author: L. Oddsson; e-mail: lars.oddsson@allina.com