

Project Name Passive Motion Chair

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Problem Statement: Studies have shown patients above 64 years of age spend on average 6-9 hours per day sitting down. Sedentary lifestyles have been proven to increase risk of developing joint-related problems, while exercise has proven to relieve symptoms of arthritis, osteoporosis, and knee stiffness. The passive motion (PM) chair is a device that can be used in place of a living room recliner and provides continuous passive motion (CPM) therapy to the knee joint. PM therapy is a rehabilitative practice of assisted repetitive motion of the joint; the device is entirely responsible for movement during therapy. Most devices currently on the market require professional assistance, lack portability, and are expensive. These parameters were what helped determine the main design requirements of the CPM Chair.



Challenges: The primary challenges faced during the development of the device were aesthetic and noise. The chair is meant to be used in the patient's home, therefore a quiet and subtle device must be designed. Noise was the greatest challenge, directly relating to limited resources. For future work, an actuator that produces a maximum of 30dB while a load is applied would be ideal.

Solution Method: The electrical system consists of two linear actuators, a Raspberry Pi, an Arduino Mega, and two load cells. From the touchscreen interface, the user will be able to create user profiles specifying angular range, velocity of extension and cycle time. The Raspberry Pi is connected to the UI, controlling the Arduino Mega, which controls the actuators. The load cells detect the force applied against the leg extension, cutting off power if excess resistance is detected. This was implemented as a safety precaution in the event the user experiences increased knee stiffness or pain.

The mechanical design of the device consists of two subsystems: the prefabricated chair and the modular component. The extending leg rest will serve as the mechanically functional component of the device. The carriage system is positioned by the secondary actuator which controls the height adjustment. The secondary actuator positions the pivoting axis of the leg rest to the back of the patient's knee, allowing for safe and effective CPM therapy. The system's main actuator is responsible for angular extension.

Future Work: A backup battery may be implemented in the case of power outages. Also, actuator selection can be optimized to decrease the sound produced to reach an ideal limit of 30 dB.

Conclusion: The passive motion chair is a chair that utilizes a linear actuator to provide its reciprocating motion which provides continuous passive motion as an option to people during their daily routine. This would help people who live sedentary lifestyles overcome the aggravation of joint pain.