THERAPEUTIC TREAD - MILL AND FOOT PEDAL FOR PHYSICALLY CHALLENGED CHILDREN

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Introduction:

Children with physical disabilities often face significant challenges in developing and maintaining motor function, cardiovascular fitness, and overall physical well-being. Conditions such as cerebral palsy, muscular dystrophy, and spinal cord injuries can severely limit mobility and independence, impacting the quality of life and psychological health of affected children. Effective rehabilitation strategies are crucial for enhancing physical abilities, promoting independence, and improving overall well-being

Therapeutic treadmills and foot pedals have emerged as valuable tools in paediatric rehabilitation. Therapeutic treadmills are designed to support and challenge children as they work on walking or running, providing customizable speed, incline, and safety features. These treadmills are particularly effective in improving gait, balance, and muscle strength, key components of motor function that are often compromised in children with physical disabilities.

Foot pedals, used during seated activities, offer a complementary therapeutic approach. These devices engage the lower limb muscles in a low-impact, repetitive motion, promoting muscle strength, coordination, and cardiovascular fitness. The use of foot pedals can be particularly beneficial for children who have limited ability to stand or walk but still need to engage their lower extremities in meaningful physical activity.

The integration of technology, such as virtual reality and biofeedback systems, further enhances the therapeutic potential of these tools. These technologies provide engaging, interactive experiences that can motivate children and provide real-time feedback on their performance, helping to optimize the effectiveness of rehabilitation sessions.

Objectives:

1. **Rehabilitation Support**: Design a specialized treadmill and foot pedal system that aids in rehabilitation therapy for children with physical challenges, particularly those affecting lower limb mobility.
2. **Adaptive Design**: Create equipment that accommodates various physical limitations through adjustable settings, supportive features, and child-friendly ergonomics.
3. **Therapeutic Efficacy**: Develop a system that effectively improves motor skills, muscle strength, coordination, balance, and gait patterns in physically challenged children.
4. **Safety Prioritization**: Implement comprehensive safety features including emergency stops, secure harness systems, and stable support structures to protect vulnerable users.
5. **Engaging Experience**: Incorporate interactive elements, visual feedback systems, or gamification to motivate children during therapy sessions and increase compliance.
6. **Accessibility**: Ensure the equipment is usable across a range of disabilities, ages, and physical conditions with minimal assistance required.
7. **Clinical Integration**: Design the system to complement existing therapeutic protocols and provide measurable outcomes that therapists can track and document.
8. **Durability and Maintenance**: Construct using materials and components that withstand regular use in clinical settings while remaining easy to clean and maintain.

Methodology:

The motor is connected to both to treadmill and Foot pedal with the help of a pulley and belt treadmill is equipped with safety harnesses and adjustable speed systems.

Foot pedal which is connected to same motor of treadmill has adjustable resistance levels, suitable for use during seated activities, and equipped with safety straps to secure the feet.

In the proposed model, children will begin exercising with foot pedals designed for proper posture and grip. These pedals come with specially designed shoes that ensure the child's legs are positioned correctly. When the motor is activated, the pedals move back and forth slowly, helping to stretch the child's legs and promote proper blood circulation.

After several weeks or months, when parents or doctors observe an increase in the child's leg strength, they can transition to using a treadmill. Initially, the child can sit in a specially designed chair that allows their legs to move freely. This setup facilitates a slow and steady walking motion, which helps improve their walking abilities. As the child becomes capable of standing, the chair can be removed, allowing them to walk on the treadmill like normal.

There are only few exercising and workout equipment's available especially for children between 5-10 years. The device for children with disabilities in order to strengthen the foot and leg muscles, actuate the nervous around the leg and also to help the patient to walk on his/her own. It is low cost, highly efficient and easy to handle.

Therapeutic treadmills are versatile exercise products used for stationary walking or running that can assist patients to improve muscle strength, endurance and recover proper walking gait. Moveable footrest helps in relaxing the leg joints and muscles by placing the foot on it, which also helps in correcting their walking.

Proposed therapeutic treadmills use a combination of sensors, audio systems, and user interfaces to produce a dynamic and interesting experience. Animal sounds and music may be synced with the steps of a toddler, generating a rhythm that develops regular walking patterns.

This aural feedback not only grabs the child's attention, but it also instils sense of success, making their habilitation process more fun and motivational.

Figure 1: Thread mill

The main frame of the treadmill uses aluminium alloy for durability and stability of the model the running base is made up of light weight steel pipes which helps good grip and durability and can hold weight up to 30kg, A sturdy frame with a wide base to ensure stability and prevent tipping. The frame will accommodate children of various sizes and weights. The grab rails which are made of aluminium alloy are wrapped with cushion to ensure the comfort and good grip for the children. The running belt is made of non-slip, cushioned material, ensuring a good grip without compromising comfort.

Figure 2: PMDC Motor

The PMDC (Permanent magnet direct current) motor is used has main drive for both treadmill and foot pedal which has quite high initial torque, with an inbuilt gear box of gear ratio 50:1. Thus reducing the speed from 1500 rpm to 300 rpm, Motor is rated for 0.5HP, 180v and 2A which can easily handle weight up to 30-35kg. For controlling the motor speed, a VFD (Variable frequency drive) is used.

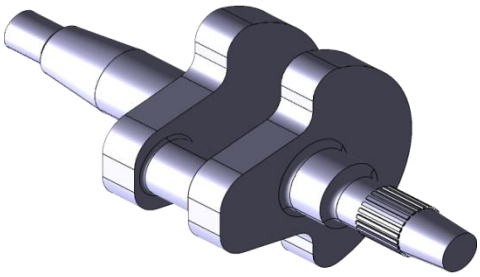

Figure 3: crank shaft

The foot pedal is made of two crank shafts for prototype model which is connected to the same motor and moves in to and fro motion the tip of each crank is connected to shoes which keeps the foot in place and helps to shape the foot of the children

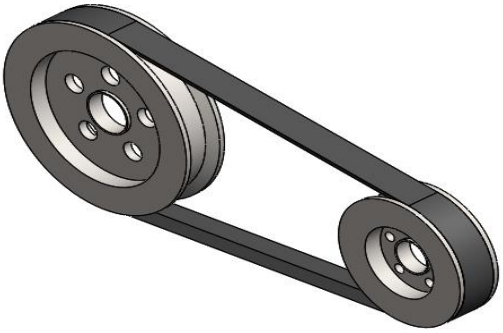

Figure 4: Pully and Pully Belt

The belt, which loops around the pulley, facilitates this transmission. The friction between the belt and the pulley allows for effective power transfer, making it possible to drive machinery over longer distances compared to gears.

There are pair of pulleys are used in the operation of thread mill and a foot pedal. They both are of different gauge sizes. One of the pulleys is linked in between the crank shaft for the rotation of foot pedal and another pulley is used for the rotation of the thread mill. We have used v-type pulley belt.

Result and Conclusion:

The project incorporates the idea of children's therapeutic treadmill and foot pedals designed to address Down syndrome-related walk, cardiovascular issues, and proper walking practice for children under the age of four to ten, with the added innovation of playing animal sounds and music while stepping, represents a significant step forward in the field of pediatric rehabilitation. The combination of technology, therapeutic exercise, and interactive features has ushered in a new era of comprehensive and engaging therapies with the potential to alter the lives of young children dealing with a variety of health difficulties.

The use of sensory stimuli such as animal noises and music not only captures children's attention but also creates a sense of accomplishment and drive through out therapy sessions. This combination of technology and rehabilitative research has the potential to transform early childhood intervention by providing personalized and pleasurable experiences that allow children to overcome barriers and reach their full potential.

As technology continues to evolve and our understanding of pediatric rehabilitation deepens, the possibilities are boundless. The integration of therapeutic treadmills with interactive elements sets the stage for a future where children with Down syndrome, neuromotor delay, cardiovascular issues, and walking difficulties can embark on a journey of discovery, growth, and achievement, guided by the harmonious interplay of science and innovation.

The proposed system Interactive therapeutic treadmill and foot pedals tailored for enhancing early childhood mobility and development in individuals with Down syndrome and neuromotor delays represent promising and impactful advancement in paediatric health care. This innovative approach not only provides therapeutic benefits but also fosters a supportive and engaging environment for children facing developmental challenges.

Future Scope:

The future scope of this project includes:

1. **Integration of Smart Technology**: Incorporating sensors and real-time feedback systems to monitor gait, posture, and muscle activity during therapy sessions, enabling therapists to adjust interventions dynamically.
2. **Remote Therapy Support**: Enabling telehealth capabilities for monitoring progress and providing guidance when in-person therapy isn't possible.
3. **AI-Driven Therapy Plans:** Artificial intelligence could analyse a child's performance data to create dynamic, personalized therapy regimens, predicting optimal durations and intensities to maximize motor development.
4. **Cost Reduction:** Advances in manufacturing and scalable designs could lower costs, making these tools more accessible to clinics, schools, and families in low-resource settings.
5. **Holistic Rehabilitation Approaches**: Collaborating with paediatric orthopaedic specialists to integrate therapeutic footwear with treadmill systems for enhanced gait correction.