Power Assisted Knee Rehabilitation Tricycle

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Figure 1. Prototype of Power Assisted Knee Rehabilitation Tricycle

INTRODUCTION

This project develops a power assisted knee rehabilitation tricycle. The purpose is to help those who have suffered various knee injuries and need to exercise in order to gain full functionality of their knees. Many individuals who suffer from severe or minor knee injuries struggle through rehabilitation treatments and lose motivation. This lack of motivation is caused by the slow progress to build back knee strength from exercising. In today's market, there are only a few bicycle options for knee rehabilitation patients to use, such as stationary bikes. The developed tricycle can be powered by a controlled motor to assist the user to drive it when they do not have full knee function, so that the speed of the tricycle does not affect the user who is rehabilitating from an injury. The user is able to change the resistance in order to slowly rehabilitate at their own pace. The power assisted knee rehabilitation tricycle will help these individuals rebuild their mobility in a more enjoyable manner.

SUMMARY OF IMPACT

The power assisted knee rehabilitation tricycle can have a substantial impact on people underdoing knee rehabilitation. This tricycle provides a fun and efficient way for users to regain their strength and get them closer to a full recovery. Many individuals who undergo these types of rehabilitation treatments are forced to stay indoors on stationary bikes. These current methods do not motivate users and make them feel less independent. This tricycle provides mobility and rehabilitation simultaneously to the users in outdoor environments.

TECHNICAL DESCRIPTION

The power assisted knee rehabilitation tricycle involves both mechanical and electrical systems.

The mechanical system of the tricycle features many modifications to an existing Alameda tricycle manufactured by Kent. A 20-tooth freewheel sprocket is added to the pre-existing rear axle on the tricycle, and a secondary axle is added to the frame, in order to transmit the torque from the motor to the rear wheel axle. This secondary axle consists of a long rectangular plate, which is welded to the frame of the tricycle, a ball bearing, a 6" long 5/8" diameter shaft, a 90-tooth sprocket, and an 11 tooth sprocket. The motor used is a 24 Volt 750 Watt electric motor. The motor is held by the tricycle's basket and mounted to the frame by using a machined mounting plate. Two clamping U-Bolts are used to keep the motor secure.

The electrical system of the tricycle is mostly held in the basket of the tricycle, including the electric motor, batteries, speed control and microcontroller. Two 12 Volt batteries in series are used to power the motor and other electronics. These batteries are safely secured to the basket. Two aluminum enclosures were purchased and holes drilled through them to store a speed control and an Arduino microcontroller. The microcontroller allows us to use software and hardware to control the system and the speed control allows us to control the motor.

The tricycle features a torque and cadence sensor that measures the applied torque by the user and the revolutions of the pedals. This feedback helps us control the desired output of the motor to supply enough power for the user. The torque sensor is assembled inside the bottom bracket and spindle of the tricycle and wired back to the basket where it connects to the microcontroller.

Moreover, at the handlebars of the tricycle are an LCD screen and an emergency braking switch. The emergency braking switch is attached to the right handlebar brake and will trigger when pressed. The brake will shut off all of the power to the motor and stop the tricycle in case of any emergencies. The LCD screen is mounted to the middle of the handlebars with a bike mount holder and a machined enclosure. It is used to display information to the user, such as the speed, cadence, torque, and battery life. It also lets the user select the desired resistance level.

The cost of the parts and supplies for this project was about $1100.

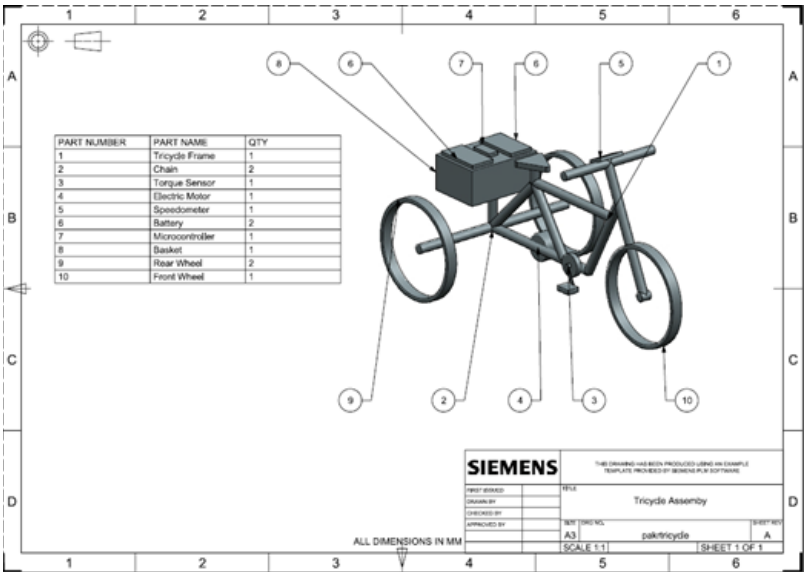

Figure 2. CAD Drawing of Power Assisted Knee Rehabilitation Tricycle