PNEUMATIC DAMPING PROSTHETIC LEG FOR ABOVE KNEE AMPUTEES

ABSTRACT

In India, there are a large number of amputees, either amputated due to an accident or a disease. A good number of these are above knee amputees. Even though many prosthetic legs are available in the market, a low-cost prosthetic leg with good functionality is still unavailable. Low cost ones like the Jaipur legs provide only support and feedback-based prosthetic legs costs around 35 lakhs. We aim to develop a feedback based prosthetic leg in the reach of common man. Our idea is to incorporate a proportional solenoid valve controlled pneumatic damping system in prosthetic legs. Proportional solenoid valves are able to achieve varying valve opening positions according to electrical signals for various phases of walking. The sensors in the prosthetic leg gather live data to provide a natural looking walking style. The operation of our prosthetic leg is also noiseless and safe.

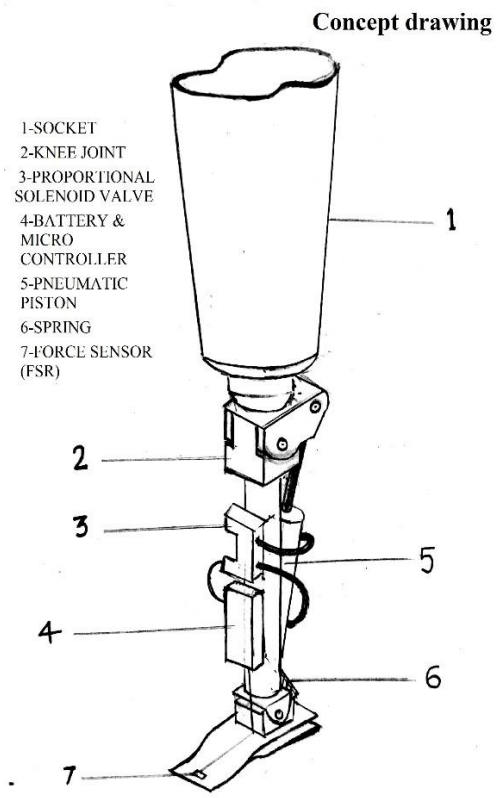
INTRODUCTION

Many of the amputees in India depend on low cost prosthetics. In Jaipur, about 150 patients show up every day that create low cost prosthetic leg with limited functionality. With a low technology investment in the area, the nation has paved way to international market to make big profits rather than addressing the issue on a larger scale. In India where many amputees are struggling for mere survival, the chances of affording a high cost limp seems low.

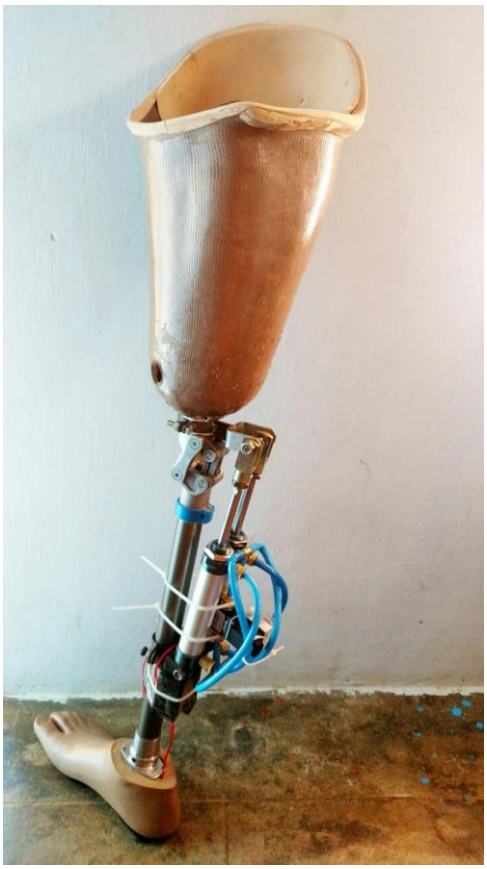
Many of the prosthetic leg available in the market with good functionality are way beyond the reach of common man due to their price, a low-cost prosthetic leg with good functionality is still unavailable.

FULL DESCRIPTION OF THE PROJECT*

Concept sketch



1st prototype



NOVELY OF THE PROPOSAL

The idea is to incorporate a proportional solenoid valve controlled pneumatic damping system in a prosthetic leg for above knee amputees. Proportional solenoid valves are able to achieve varying valve opening positions according to electrical signals. This feature can be used to achieve varying hydraulic damping effect in prosthetic knees according to different phases of walking such as stand phase, swing phase, etc.
FEATURES

1. Purely mechanical legs uses passive mechanism less adaptive to ground level or gait speed. The main differences in the design of intelligent and passive prostheses are in their damping systems because an adequate damping allows for fast transitions in stride velocity, which increases the autonomy of the amputee. Sensors in this intelligent prosthetic leg gather live data and compare with normal walking cycle to get a naturally looking walking style. Since no motors are used, operation is noiseless.

2. Low cost prosthetic legs like Jaipur leg locks and transfer load to the ground only when load is acting normal to the ground, when the leg is in a bent position such as riding a scooter or using a stair, it won't lock and amputee may fall down. The pressure sensor in our prosthetic leg will sense increase in weight and the piston locks. The proportional solenoid valve unlocks the piston only when 70% of the total weight is transferred to the normal leg.

3. If by any chance, a technical problem occurs, the prosthetic leg will work as a common mechanical leg. This is a fail-safe feature added in this prosthetic leg.

WORKING

A force sensors at the foot detect the pressure applied by the amputee and enables to adjust the resistance of hydraulic system accordingly using proportional solenoid valve.
End of stand phase micro controller recognizes the reduction in foot pressure and opens proportional solenoid valve. The swing phase would start only if 70% of the total body weight is transferred to other leg. Compressed air inside the cylinders provide more walking assistance to amputees.
The second mode activate free swinging for activities like bicycling. To switch between modes a knob provided at the knee is turned.

Applications:

- Rehabilitation of poor amputees doing tedious jobs for living.
- Rehabilitation of soldiers amputed in warfare.

IV. CONCLUSION*

We have a friend who is an above knee amputee. His right leg was amputated two years ago. Even though his family managed to buy him a hydraulic mechanical leg, it's difficult for him to walk. We asked him about the difficulties while walking and doing other activities. He shared his experience while using his old Jaipur leg and current leg. He also gave us some suggestions to improve the functionality of our idea such as incorporating a walking assist mechanism which stores energy in a spring while load applied, and release it while swing phase of walking This gave us the thought that why a feedback-based low cost leg is still unavailable in India.

So we made our first prototype according to his leg dimension collecting feedback from him for further development