Indian Institute of Technology, Bombay Department of Mechanical Engineering **ROBOTICS LAB**

5-8-2002

Nataraj India's biggest Walking Robot Steps out at IIT Bombay

Nataraj, the Walking Robot, designed and built at the Robotics Lab, Department Mechanical Engineering, IIT Bombay is one of its kind in the world and the largest (over six feet tall) built in India.

Six legs provide Nataraj the capability to walk, turn, climb stairs and step over obstacles, features which are often required for negotiating uneven terrain and moving around in disaster areas strewn with debris. Nataraj can carry tools, cameras and manipulator hands for inspection, repair and maintenance.



The six legs are mounted on the sides of a hexagonal chassis and the robot appears like a giant spider. Several styles of walking are possible – crab gait, gaits akin to spider's gaits and so on.

Nataraj weighs about 250 kilos and can cross 100 meters of level ground in about 15 minutes. It can step over obstacles 45 cm high. Nataraj has been tested with a payload of 50 kilos but is capable of carrying more. With the installation of a battery pack in about a week, Nataraj would be able to operate independently.

Systems

Each of the six legs of Nataraj is powered by three servo motors. One motor powers the up-down motion of the foot; a second moves the foot parallel to the ground and a third enables the leg to pivot around the hip. Coordinated motion of the six legs required for a "walk" is through simultaneous operation of all eighteen servo motors. An onboard electronic system consisting of eighteen motor drivers, associated controllers and a supervisory computer provide the requisite power and control.

Nataraj responds to high level commands like "Walk forward, Squat, Turn, Climb". These commands can be used to program Nataraj to execute repetitive tasks involving, among others, negotiation of ramps, and stairs. Remote control of Nataraj is possible through the internet and in a recent experiment the robot was operated from Bangalore.

INDIGENOUS DEVELOPMENT

Indigenous motors, ball screws and gear boxes have been used for powering Nataraj. Many of these were developed to suit our specifications. The body and the legs are of aluminum and the replaceable feet are made of teak wood, with tennis balls as shoes.

All systems, mechanical, electrical and electronic, have been designed and developed from scratch at the Robotics Laboratory, using mostly indigenous components.

The first tentative steps taken by Nataraj on 10 May 2002, were the culmination of several years of effort by a large team of students, staff and faculty at IIT with support from DRHR of BARC. Alumni of IITB pitched in to help in the design and fabrication of many a sub-system. This development activity has been a basic training ground for several aspiring designers. The entire effort was funded by BRNS.

Nataraj is essentially a "Proof of Concept" and would now be used as a basic platform for further experimentation and studies on sensory control and autonomous activities. Future generations of Nataraj are expected to be lighter, swifter and more sophisticated.

Development of Nataraj has been a source of inspiration to several students at IITB over the years. Enthused by, and being proud of their association with the development of Nataraj, several students have gone on to construct several walking robots, and other automatic devices. This increasing interest in Design has also led to greater successes in International student competitions.

Video clip on Nataraj's first walk is available at http://www.iitb.ac.in/latest/natraj/