

Ingenious Human and Incredible Humanoid



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DR. VADAKKEPAT, an Assistant Professor at the National University of Singapore is the founder secretary of the Federation of International Robot-soccer Association (FIRA www.fira.net) and currently its General Secretary. He is also the founder director and chief mentor to an entrepreneurial start-up "Robhatah Robotic Solutions" at Singapore [www.robhatah.com]. His initiative among others includes an international conference on Computational Intelligence, Robotics and Autonomous Systems [<http://ciras.nus.edu.sg>] which is being held successfully since 2001. He was the general chair to the FIRA RoboWorld Cup and Congress 2005 which was held in Singapore [<http://fira.nus.edu.sg>].

"IT IS MY PASSION TO
WORK WITH ROBOTS.
I DREAM OF A WORLD
WHERE HUMANS AND
ROBOTS LIVE IN HARMONY."

DR. VADAKKEPAT is an associate editor of the International Journal of Humanoid Robotics. His Humanoid robot and robot soccer teams have consistently won several international prizes. The latest include first prize and overall championship in Humanoid robot soccer at the FIRA Robot World Cup (Germany 2006, Singapore 2005 and Austria 2003), First Prize (open category) in Singapore Robotic

Games (2004) and Second prize in FIRA 2004 (first Prize was won by a robot sold by his start-up Robhatah).

He was elected as the Secretary to the IEEE Singapore Section for the year 2005. He has served as Technical Activity Coordinator to the IEEE Region 10 (Asia-Pacific) in 2001-2002. He is also a Fellow of the Institute of Electronics and Telecommunications Engineers (IETE), India.

He is also actively involved in various technical forums including conferences, symposia and robotic competitions. He has been featured in several prominent newspapers and TV shows in India, Singapore, USA, Korea, Spain and France.

DR. VADAKKEPAT received his M.Tech and Ph.D. from Indian Institute of Technology Madras, in 1989 and 1996 respectively. He was a Lecturer at the Regional Engineering College Calicut, India from 1991 to 1996. While pursuing Post-Doctoral studies at the Korea Advanced Institute of Science and Technology (KAIST, 96-98), he was awarded the Korea Science and Engineering Foundation (KOSEF) fellowship. Since 1999, he is with the National Univ. of Singapore.

His research interest include Distributed robotic systems, Humanoid robotics, Biomorphs, Neuro-Fuzzy Controllers and Intelligent Control techniques and, has publications in several leading international journals.

A tete-a-tete with Dr.Prahlad

1. When did the concept of MANUS 1 occur to you?

It all occurred in the year 2002. I visited South Korea then, and came across with a humanoid project that was being undertaken at one of the laboratories in KAIST (Korea Advanced Institute of Science and Technology). Added to which, I was bed ridden in the year 2001 due to Deep Vein Thrombosis (DVT) blood clots in the veins. I had some difficulties with my leg muscles then and was on wheel chair for 6 months. These two incidents paved the way for developing a humanoid robot. By working on humanoids, we aim to learn on the gait generation aspects, and one day the research findings will pave the way for utilizing them for those who are handicapped.

2. How long did it take to build it?

The first working prototype took almost a year to build. Since then improvements along mechanical design, electronics and various sensors have taken place on a regular basis.

3. How did you form the team with your students?

I challenge the students to do the best they can.

Zhang Ruixiang joined me in 2002 to pursue MEng programme, and I suggested the humanoid project to him. One undergraduate student Mr. Janesh Janardhanan helped him along the mechanical design using one of the CAD packages.

4. Can you tell us more about your team?

In 2004 we founded Robhatah Robotic Solutions [www.robhtah.com], a NUS spin-off to market Manus. Mr. Janesh Janardhanan is the CEO of the company and Mr. Zhang Ruixiang is currently pursuing his PhD at Stanford.

Several students have contributed to Manus since 2003.

5. Any experiences which you want to share with our readers that happened while building MANUS 1?

Manus was designed from scratch without any prior knowledge or experience. The design was completed using Solid Works. Through intensive discussions and common sense approach the design evolved. Many a times, it was common sense which assisted us.

For gait generation and testing the Yobotics package was utilized. The initial designs did not work at all. Over a period of time, through discussions and intensive literature survey, and common sense, we developed several gaits. The stable gaits were ported over to the hardware and fine tuned.

6. Why the name MANUS 1?

Manus is derived from the Sanskrit word 'Manushya' meaning man.

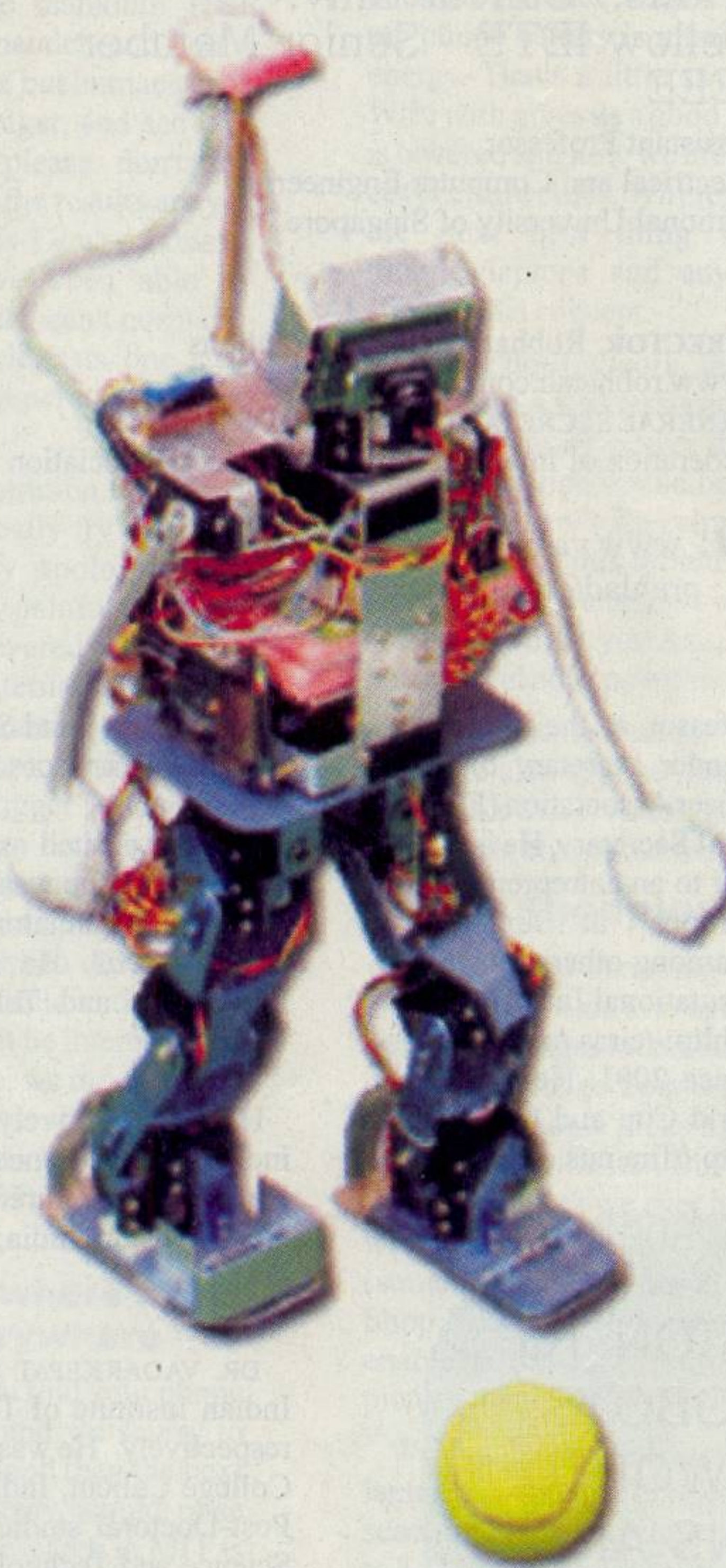
It also refers to our lab: The Mechatronics and Automation laboratory of NUS

7. Can you describe this automated guy?

With a height of 46 cm and a weight of only 2 kg, the Manus is small in size but it has a sophisticated overall mechanical structure. Manus has 17 degrees of freedom (DOF); there are 17 joints powered by motors which must be controlled simultaneously for the robot to even stand up (if unpowered, the structure simply crumples into a heap just like how a bicycle chain would). In order to realize a natural gait, the joint design of the robot is modeled on the

structure of the human body, with each 6-DOF leg enabling the robot to imitate most of the human walking motions. The robot senses its environment through a combination of eight force sensors, one tilt sensor, an IR sensor, a digital compass and a video camera. To coordinate its sensory information and walking, the robot uses a two-layered control system. The high-level control layer gathers and processes the information from the sensors, decides on the necessary walking motions and directions, and sends commands to the low-level controller. The low-level control then processes inputs from the tilt and force sensors, and realizes the walking motions and any special motions such as kicking a

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ball.

Manus' functionalities include visual-tracking and walking towards colored targets, dynamic walking, obstacle avoidance, climbing stairs, and getting up from a seated position. Manus is a fully modularized and open architecture platform, so developers can modify and add new features.

Manus holds world championships over several years and it has set a number of world records.

8. *What are the future enhancements you are planning for him?*

We are in the process of attaching hands to Manus with which it can get down to a lying state and then to get up. The hands also assist in balancing while in motion.

Robot to robot communication via Wi-Fi is being implemented to enable Manus along collaborative activities.

It is aimed to make Manus interactive in nature through visual cues and audio.

Better and natural gait generation is an area that will also be looked in to in the immediate future.

9. *Which international stages did MANUS 1 feature on?*

Awards:

First place, FIRA Robot World Cup Germany 2006

First place, FIRA Robot World Cup Singapore 2005

Second place, FIRA Robot World Cup Busan, Korea 2004

First place, Singapore Robotic Games 2004

First place, FIRA Robot World Cup Austria 2003

10. *Can you give a few suggestions to a naive robotics enthusiast (what are the areas he needs to concentrate, the skill set required, how should he keep himself abreast with emerging trends etc).*

Irrespective of the stream of engineering one pursues, be bold to explore multi-disciplinary areas mechanical design, electronics, micro-controller programming, wireless control and on various sensors.

The first and foremost step is to learn how to control a

motor, may be directly from a PC. Microcontroller programming comes next. There are codes available over internet. [<http://sourceforge.net/>] is a good source for various open source and shared utilities and tools.

Identify peers with similar interests, and form a team for group learning and sharing the workload. Pass on the expertise to the juniors.

Assembly level to higher level programming, soldering and mechanical design skills should be slowly picked up.

Internet is a powerful medium to keep abreast with the latest in robotics and to share the ideas. You are welcome to a Blog named "Robots --- Because Humans Deserve Better," at [<http://i-heart-robots.blogspot.com/>] which we maintain.

11. *Does NUS offer any projects in robotics field for undergrad students in universities other than IIT's in India? What would be the eligibility criteria? If not, are there any plans in pipeline?*

NUS has ongoing exchange programmes with various IITs. Contact your Dean's office to know more on the exchange programmes.

It is also possible for students to carry out vacation internship programmes in NUS laboratories. Such attachments will depend on the availability of funds. It is advised to contact the concerned NUS staff, member in the area of interest, to explore the possibilities.

12. *Do you have plans to diverge your expertise in robotics field to the students back in India through Robhatah?*

Sure. Whenever I visit India, it is a practice to deliver lectures on robotics at various institutions (right from primary schools to engineering colleges).

Robhatah currently markets various laboratory related experimental setup. For more details visit [www.robhatah.com].

13. *Would you be willing to guide and contribute for any national level workshops and symposia?*

I will be more than happy to contribute to such meetings.

In December 2006, I will lead a team of NUS students to demonstrate the Manus humanoid and other robots from our laboratory in several educational and research institutions across the Kerala state. As part of this trip a workshop (NIT Calicut) and one National Conference (MES Kuttippuram) are planned.

A similar trip is planned in February 2007 across the northern states of India.

I will deliver a keynote speech at an International Conference organized by BITS Pilani in February 2007.

14. *Is there a way for amateur robotics enthusiasts to reach you?*

Sure they can contact me at [prahlad@vadakkepat.net].

15. *Your message for the young engineers...*

Challenge yourself to do the best you can.

Never loose hope and try hard while keeping a cool mental state. Be part of engineering a better morrow for the mankind.

Photos Courtesy : www.robhatah.com