

Cultivation of Innovative Elites from Robot Contest in Universities

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Abstract - The main mission for higher education is to train innovative elites, talented in innovative awareness, mind, ability and personality. One important field of innovative elites education is the practical training. Especially, robot contest, as a multidisciplinary branch integrated with high-tech competitions, is an extraordinary platform in training university students. Harbin Institute of Technology (HIT), has established a laboratory for the students who participate in the robot contest and robotics research. This lab, operated in open management mechanism, especially based on student self-management, is formed to an innovative training system.

Index Terms - Robot Contest, Innovative Students, Creativity Ability

1. Introduction

It is a challenging subject to train innovative students, and improves their creativity ability in the long run of higher education. A consensus is reached in the global education: creativity training, engineering quality and overall quality improvements are complementary and harmonic to each other. HIT, based on the Asia-Pacific Robot Contest (ABU-Robocon), has established a platform integrated with engineering training, entrepreneurship training, technology innovation training, scientific research, overall quality improvement. Meanwhile, HIT has created a mode to train students' creativity ability from the robot contest, and built a technology innovation atmosphere with science advocating, hardworking, and also cooperation.

2. The Essence of Innovative Elites

Innovative elites are those with innovative awareness, mind, ability and personality. They can successfully accomplish innovation activities with innovative achievements. Innovative elites should be qualified with:

A. Innovative Awareness

Admiring innovation, pursuing innovation, and be proud of innovation. Be good at and even has a strong sense of questioning. Promising to devote into technology and technique development and has a strong desire to carry out inventions.

B. Innovative Mind

Never follow the routine, be daring to break the traditional concept, be perceptive and imaginative, so that the mind is always "in advance".

C. Innovative Ability.

Be prepared well with solid foundation of knowledge, broad vision and an ability of good comprehension and opening up new areas. Be mastering in innovation approaches, including the ability to acquire knowledge and its application, the capability of information processing and scientific research, engineering ability. Also, be capable to be familiar with innovation methods and to apply them into creative activities and invention.

D. Innovative Personality.

Be determined on devoting himself/herself into the science and humanity; be daring to take risks, to doubt and to criticize. Has a good mentality and emotion, be able to evaluate the innovation, direction and level, such that the effectiveness and sustainability would be guaranteed.

3. Practical Training is Important for Innovative Elites

Presently, traditional teaching pays more attention to convey professional knowledge to students, centered with teachers. Students are passively learners, with their enthusiasm never been stimulated, hence it is difficult to improve students' engineering ability and innovation. Practical training is an important part in higher education, helps students comprehend and implementation of knowledge; hence it is an effective way to improve the students' ability of problem analysis and solving. Reasonably and effectively carry out practical training in universities, is one essential step for innovative elites education.

Participating in various academic competitions is an important way to improve student's creative ability, since discipline contest is a very important part in practical training. As a high-tech competition, the ABU-Robocon is a combination of multidisciplinary and multi-professional knowledge and a great platform for college students to improve their practical innovation ability. Participating in this contest, students design and fabricate robots, with the combination of theoretical knowledge with the practices. Further more, students find the problems, analyze the problems and also solve the problems, with respect to the actual situation. In this process, their engineering ability and innovation awareness are improved. Robots design requires the cooperation between the students, hence the robot contest can improve students' desire and capability of collaboration. At last, designing and fabricating of robots takes a lot of spare time, especially during the crucial days before the contest,

students usually need to work overnight as a tight schedule, and hence it can enhance the students' spirit of hardworking.

4. Innovative Elites Education Mode Based on the Robot Contest at HIT

HIT began to participate in the ABU-Robocon from 2002. Along with fruitful achievements, HIT has also trained a large number of undergraduates with solid professional foundation and strong engineering ability. During these years, HIT gradually fabricated a mode for innovative elites education based on the robot contest.

A. Innovative Training Platform for Students

Robotics involves in disciplines such as mechanical, electrical/electronics, automation, computer, sensing and so on. Robot contest is a high level technical competition, need 2 to 4 robots to be built by students, with all hardware and software work be designed, carried out and debugged by students. The students who participate in this robot contest need to know not only basic skills of mechanical parts fabrication, electrical and electronics, software development, computer hardware, but also professional knowledge of mechanical design, electronics design, software design, control algorithm, sensors and so on. However, the traditional universities don't have wide disciplines hence the intersection between those disciplines is limited and this eventually be represented by the lack of practice in actual projects training, the lack of students' creativity and innovation ability. With respect to this problem, HIT has established a step-by-step training system from basic skills training to professional skills applications, and to robotics research and innovation. The engineering training center is mainly in charge of the basic skills training, including mechanical fabrication, electrical and electronics technical skills. Professional skills applications are in the form of practice and academic competitions, in the purpose of improving the students' ability of applying what they learn to their projects. With the basic and professional skills be well trained, the outstanding students, from different majors will be form to the robot team to participate the ABU-Robocon. During this robot contest, the students need to collaborate with each other to build the robots, in the aspect of mechanical design, fabrication, control system design, programming and so on.

B. A System Based on Robot Contest and Robotics Research

ABU-Robocon is a high level robot contest requires higher speed, higher precision, and higher reliability. Usually, it needs advanced schema, advanced theory and techniques in order to build competitive robots. A strong academic background is necessary to build those robots and on the other hand, the academic accumulation will promote the robot contest to a much higher level. The system established by HIT, with the robot contest and robotics research support each other, has achieved a high integration of engineering practice and academic research. The centralized control system developed by HIT robot team, implemented with advanced microcontrollers, embedded operating systems, is really

powerful in controlling the robots. Advanced sensing techniques such as gyroscopes, laser range finders and so on, has improved the agility of robots a lot. An indoor global positioning and navigation system has ensured the robots' stability and adaptability.

C. Open Laboratory Management

In order to develop students' practical and innovative ability, the training platform established by HIT is managed openly, such that the students get more freedom in using the lab resources. It is important for the school to provide students with independent operation, design and thinking, since it is the way to develop their creativity. During these procedures, the students are easier to solve problems, and form their own views and opinions. Different from normal teaching laboratories, the open platform allows students to enter the lab at any time then it is a really good practice and research lab. Usually, the students work on their projects in the free time, within groups. In this matter, the collaborative atmosphere is formed and the senior students are more likely to teach the junior students. Meanwhile, the open laboratory requires the students to be involved in the management, which is important to develop students' spirit of collaboration.

D. The Management System is Mainly Based on Students' self-managing

The operation of the HIT robot team is fully charged from students, not from any professor, hence it becomes an important platform to develop the students' leadership, collaboration and management. In the robot team, they have instructors, captain, team leader, and team members, as well as managing group, technical group and consultant group. Democratic centralized decision making mechanism is adapted in the robot schema planning, specification decision, contest strategies and so on. For the daily affairs, like resourcing, business negotiation, team members' emotion issues, team atmosphere, project procedure and so on, are excellent opportunities to train the student leaders' decision making, collaboration and management ability.

5. Conclusions

HIT robot team has participated in all ABU-Robocon, and won the second place in domestic contest (China) in 2008, championship in both domestic and international contests in 2009, as well as the third place in domestic contest in 2011. During these years, more than 500 undergraduate students were well trained. Like Dingjiang Zhou, a Chinese "Star of Self-Fortitude" college student in 2009. And Ding Chen, the team leader of the 8th robot team, was kindly met by vice-Chairman Xi in 2009.

Under the new situation, how the universities achieve sustainable development relies on whether the universities can bring up high-quality innovative students, such as the students grew up in the robots contest. In the future work, we will keep our enthusiasm on the robots contest, and give them a strong support, as well as to improve the innovative training mode.

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