

# BUET takes part in Robocon 2009

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THE story began a few years ago. Some very energetic students approached Professor Dr. Zahurul Haq- "Sir, we want to take part in an international robot contest." At first he was a bit skeptical. Robotics is an advanced field of applied engineering. Modern robots are made of hundreds of sophisticated sensors and state of the art control system. Most of the materials are not even available in Bangladesh. And the BUET team has to compete with universities from Japan, China, Malaysia, Singapore, Korea and other technologically advanced countries. But the enthusiasm in his students encouraged him to agree take up the challenge. Thus the *Mechbu* team took part in ROBOCON 2005 and earned the very prestigious 'Panasonic Award'. From then on department of Mechanical Engineering is competing in this contest every year.

This year's competition is going to be held in Tokyo, Japan. Asia-Pacific Broadcasting Union (ABU) is organizing the contest, which is more popularly known as ROBOCON. Only 22 teams from Asia including BUET team have been selected to compete in the tournament scheduled for the 3<sup>rd</sup> week of August. All the participants are under-graduate students of the Mechanical Engineering Department.

To participate in ROBOCON, a number of robots are to be built that can complete a series of tasks within 180 seconds. These tasks are based on a theme that generally comes from a traditional story of the host country. The number of robots and the rules vary year to year depending upon the theme. There is one manual robot directly controlled by the

operator while the other robots are fully autonomous. The robots used in the contest must be handmade by the students of the university.

The core item of this year's contest is the Kago (similar to our *palki*), the traditional Japanese palanquin or lifter of the pre-modern era. People were often carried in Kago to distant places. The Kago was a basket sus-

that are to be crisscrossed) while carrying the Kago with the Traveler Robot on the Seat. The Kago and Traveler Robot must not be dropped. The Traveler Robot must beat the Victory Drums when it reaches the Goal Zone. Three traditional Japanese drums are arranged vertically on a platform. The team that beats all three drums first is the winner.



ended from a wooden pole called the Shoulder Pole. Travel in the olden times was far from smooth. The bearers who carried the Kago had to cooperate very closely to reduce the sway and complete the journey safely.

The actual game is based on an imaginary journey of olden days using the Kago palanquin. An Automatic Carrier Robot in the front and a Manual Carrier Robot in the rear shall cooperate to carry an automatic Traveler Robot in a Kago with the aim of completing the journey before the other team. Various tasks stand in the way, including passing a Mountain (17° slope) and Woods (simulated by three wooden poles

The theme of ROBOCON 2009 is *Cooperation between people and robots*. From the very starting manual robot operator has to be very careful and cooperative with the automatic carrier robot for proper synchronization of speed and balance. It is a disqualification if the carrier robots touch any part of the kago other than shoulder pole at any stage of the game. The shoulder has to be hung with proper balance. While passing the woods neither the kago nor the traveler may touch the wooden poles. Traveler robot has to have the capability to sense its arrival at the destination, the kago zone, and alight from the kago by itself.



Again, no signal can be sent to the traveler though manual robot may touch it after reaching kago zone. Traveler is intelligent robots that can take decisions like when to board the kago, when to alight from the kago, how to reach the goal zone and how to beat all the three drums. The top-most drum is 1.7 meter above the ground while the design of the traveler should be such that it can seat in the kago whose height is only 0.8 meter without touching any part of the kago.

Building robots is always a challenge. Robots are complex systems, which rely on software, hardware, and mechanical systems all working together. Even after building everything successfully various types of complex interactions occur, which usually can't be anticipated. The situation is much worse in Bangladesh due to unavailability of required components. Motors are bought from *Dholaikhal* where only used materials are available. Good motor is almost impossible to find. BUET team is using same motor for the drive system since ROBOCON 2006 as no better alternative has been found in the past four years. Mechanical components are also designed by the team and are fabricated in the workshops of BUET including Machine shop, sheet metal and welding shop, carpentry shop. Stainless steel, aluminum and wood are used to make the structure of the robots. The wheels are made of nylon and then coated with a thick layer of rubber pad to ensure maximum traction.

The control system of each of the three robots is PIC micro controller based. Micro controller serves as the brain of the robots. The game plan is stored in it through programming. Different types of sensors have been used to work as the eye of the robots. Sensors, specially designed by the *Mechbuet* team, are attached with each wheel to achieve motion data. Limit switches have been used for position sensing. Micro controller then does the necessary calculation based on the inputs from the sensors and predefined programme, takes

decision and generates control action. The micro controllers used in the robots can execute one million instructions per second.

To fine-tune the motion another micro controller based system has been developed to monitor the motion of each robot wheel, current drawn by the motors and some other key parameters. This system utilizes RS-232 serial communication system and is able to send data directly to a computer or laptop at a rate of 230Kb/s.

The robots are very advanced in terms of control system. Motor control system is capable of achieving up to 0.5-millimeter accuracy. Pulse

2005, first time in international competition as such, BUET team received a wide media attention for their simple and cost-effective design approach using scrap and used materials. The team was awarded the *Panasonic Award* for innovative, sustainable, low cost design. Also BUET was the only team from SAARC countries to win a match in the Robocon, 2005 Beijing.

In ROBOCON 2007, the BUET team was defeated by Surabaya Electronic Engineering Institute, Indonesia in the knock out round who became the Runner's up of the tournament. BUET was defeated by Xi'an Jiaotong University, China who



Width Modulation (PWM) is used for motor control. The robots utilize dynamic braking system to avoid the effect of inertia. For better reliability and precision feedback control system checks everything 100 times per second and takes corrective measure accordingly. The circuit is designed to give maximum versatility. Programming is done using MPLAB Integrated Development Environment (IDE).

ROBOCON 2009 is the fifth consecutive participation of BUET in this contest. It should be mentioned here that BUET is the only university that has qualified for ROBOCON for five continuing years. In ROBOCON

became the ROBOCON champion 2008

Despite all the limitations BUET students are trying their best to uphold the honor of our country. And they are doing it without much help from anyone. "We don't want financial support. Just give us work. If the government needs any robot for defense or any other purpose give us that opportunity instead of importing. May be it won't be that good at the first year. But next year it will definitely improve. Within a few years we will develop our own robot building and automation technology inside the country" says the expectant students.