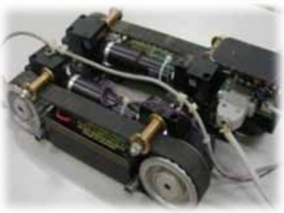
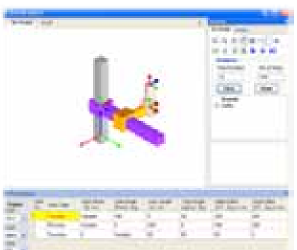




President's Message:

"Just as the purpose of forming the Society has been to bring together Robotics researchers from all corners of the country, the Newsletter tries to connect institutions by reporting research works being pursued there, and various other facts and events of interest to the Robotics community. The first issue of the Newsletter is being published and distributed on the occasion of the International Workshop in Robotics being held at IIT Delhi to mark and emphasize the coming together of Robotics researchers of the country. I wish and hope, this spirit will prevail and strengthen in the coming years through reporting of high quality and diverse research work related to Robotics in the pages of the Newsletter. I urge you all to join in and contribute to this process wholeheartedly".

Mr. Manjit Singh, Distinguished Scientist and Director, Design, Manufacturing and Automation Group, Bhabha Atomic Research Centre, Mumbai, India.

Brief note on Robotics Society of India: (www.rsindia.org)

An idea whose time has come! Robotics society of India, 10th July 2011, IIT Delhi.

In the last few years robotics activities in India has moved well beyond the traditional areas of industrial applications, atomic energy, etc. and entered newer domains of education, rehabilitation, entertainment, and even into our homes. Indian robotics researchers have similarly grown from a handful to over a hundred engaged in different research labs, academic institutions, and even training students from engineering colleges and secondary/higher secondary schools in the form of Robotics Workshops. Many of us feel that it is about time to form an academic society to further augment our robotics activities and for better interaction among ourselves. With this intention the Robotics Society of India was formed on 10th July, 2011. The main objectives of the RSI are:

1. Encourage interaction between robotics researchers in India.
2. Hold joint workshops and conferences at the national level.
3. Associate with other organizations like IEEE, ASME, etc.
4. Publish a newsletter, proceedings, journal etc.

Newsletter editors note:

Finally the auspicious moment has arrived and the first issue of the Newsletter of the Robotics Society of India is here. I am very proud to be the editor of this first issue of the Newsletter. We must acknowledge and thank the efforts of all the contributors. The Indian Robotics Research scenario is quite rich with many government sponsored laboratories, universities, colleges, amateurs, clubs and forums engaged in design, development, and troubleshooting of robotic systems. I hope this Newsletter will act as a great workspace, conducive for nurturing as well as exchanging ideas, not only for the Indian robotics professionals but also for the amateurs and students who are interested to explore the adventure of designing and developing robotic systems. I believe that a revolution in Indian robotics is not very far away. I hope you enjoy out first newsletter.

Ranjit Kumar Barai, Electrical Engineering Department, Jadavpur University, Kolkata-700032

Robotics in BARC: A journey through three decades

Prabir K Pal
Division of Remote Handling & Robotics, Bhabha Atomic Research Centre, Mumbai

When I joined BARC, there was no Division for R&D in Robotics. However, there was a 'Remote Handling Section' in the Central Workshop (now Centre for Design & Manufacturing). They had designed and assembled the first indigenous Master Slave Manipulator (MSM) for handling radioactive materials remotely in Hotcells. Considering that MSMs are required in large number in almost all nuclear installations of the Department of Atomic Energy, and their design is intricate at the least, that was the first and most significant success of BARC in technology development in Remote Handling and Robotics.

The Remote Handling Section was the seed around which the Division of Remote Handling & Robotics was formed in 1984. For the first couple of years after its formation, it was still physically located in the Remote Handling Section inside Central Workshop. Subsequently it shifted to an adjoining shed with ample space for workshop. Much of the initial attempts of building Robots and Automation Systems took place here. The subject was exciting, so many young people joined in. Many robots were built and programmed. Very few found applications, but we were learning the hard facts of robot design and control. We realised that building toy robots for demonstration was relatively easy, but building a robot to meet demands of a real application – that too in a radioactive environment – is extremely difficult.

The next phase of development tried to bring in corrections to our approach by defining clearly the objective and scope of each activity, and by working out detailed specifications of the desired end product in advance. Industry participation was on the rise. There was no hesitation in procuring components, software and even robots to build a system that works. We imported mobile robots and industrial robots to learn how they are organised, and how they can be used in our applications. Meanwhile we moved to a new Building where sitting arrangement is nice and comfortable, and there is adequate Lab-space in each floor for setting up and testing robotic systems. The workshop continued at the old place. Our mandate is to develop useful robotic applications in DAE or elsewhere on our own, through industries, or by integration of commercially available components including robots.

Through several iterations over more than a decade, the mechanical MSM technology matured and resulted in a number of models for a range of payloads and applications. They are now routinely manufactured by the Industries for use in the DAE Units. In parallel, the servo manipulator technology was also pursued, and a working model was installed in the Waste Immobilization Plant in BARC. This technology has been further enhanced to build Advanced Servo Manipulators (ASM) and Telerobots. The ASM implements variable force feedback and motion mapping under computer control. Despite its success, the ASMs are difficult to install in existing hotcells. For that reason, a variant of this, named Four Piece Servo Manipulator, where the whole thing is split into four separate parts for ease of installation, has been developed, and is being tested.

Mobile robots are very useful for remote survey and inspection in radioactive areas. We developed the mobile robot 'SmartNav' for performing experiments in autonomous navigation, and demonstrating applications in remote survey. This helped us in understanding and organising the building blocks of a mobile robot. With this experience, we went ahead and built a mobile robot with onboard manipulator, and removed boxes of fuze-mines remotely by teleoperation at Ordnance Factory, Khamaria, Jabalpur. We also deployed a SmartNav-like mobile robot for radiation mapping around the room temperature

(left) Four Piece Servo Manipulator for existing hotcells
(right) Automated Material Transfer using AGV

(left)Immersive interface for teleoperation of an industrial robot
(right) 3-DOF planar parallel manipulator

cyclotron of VECC, Kolkata. We are developing a mobile robot named 'Radmapper' exclusively for this kind of applications in cyclotrons and accelerators. The radiation map helps in identifying points along the beam trajectory where there is significant leakage of ion beams. Radiation mapping may also be necessary in outdoor areas, so we are trying to build wheeled and tracked robots for outdoor navigation. On another front, we developed an Automated Guided Vehicle (AGV) based Material Transfer System for use in a manufacturing environment. The specifications came from Bajaj Auto Ltd, Pune, where the prototype AGV is currently undergoing tests. We are also working on two AGV applications in NFC Hyderabad – one for transfer of pellet boats in the Sintering Unit, and another for transfer of tubes in the Zircaloy Fabrication Plant.

Industrial Robots are commonly used for pick and place applications in a structured environment. If the locations and orientations of objects to be handled are uncertain, Computer Vision has to guide the robots. We used a Cognex Smart camera to locate fuel pellets on a table for handling by the manipulator (Kuka KR-6) for inspection, density measurement, and stack preparation. We have also installed a force-torque sensor on the wrist of the manipulator to program peg-in-hole insertion, contour tracing and payload assist. The guiding theme in these applications is that the robot should be sensitive to the forces of interaction while handling a job. We intend to implement robotic deburring and polishing at the next stage.

While using a master-slave manipulator, the operator finds it difficult to understand the spatial arrangement in the slave environment from the limited views available from fixed cameras. We are exploring the telepresence technologies to present an immersive interface to the operator. Images from a pair of cameras are displayed on a monitor or projected on a screen, and by using synchronised shutter glasses, one gets a 3D immersive experience. We are also exploring the use of a haptic device, like the phantom omni, as a master. This necessitates innovative motion mapping from the haptic device to the slave manipulator, as well as force mapping from the slave manipulator to the haptic device. Once these devices are put on a LAN, the master slave manipulation can be done from practically anywhere.
Over the past decade, we have developed considerable expertise in the design and control of parallel kinematic manipulators.

These manipulators have limited workspace, but within that, they can be controlled very precisely even with high payloads. We are working on applications of such manipulators in beam alignment with RRCAT, Indore, and in surgery with TMC, Parel, Mumbai.

In Robotics, applications are diverse, and they call for multidisciplinary approach. In our effort to widen our scope, and strengthen ourselves with sound methods and techniques, we have from time to time joined hands with academic institutions like IIT Kanpur, IIT Bombay, Jadavpur University, Bengal Engineering & Science University, and IIIT Hyderabad through BRNS projects. In the recent past, we have clubbed up with IIT Delhi to form a Programme on Autonomous Robotics, where some of the above problems or their variants are being pursued in parallel through innovations on the latest technologies. This, we hope, will enrich robotics research in the country by posing a wide range of practical problems that are awaiting solutions.

A Multi-Agent Emotion Generating Engine

Shivashankar B. Nair
Department of Computer Science & Engg., Indian Institute of Technology Guwahati, Guwahati

Emotions by themselves form a complex phenomenon – a reasonable unified explanation for their need, generation, causes, mechanisms and overall effects have been a topic of perennial debate. Emotions could be positive such as *happiness and surprise* or negative such as *anger* and *fear*. In his evolutionary theories Charles Darwin[1] has suggested that emotions evolved due to their adaptive value. For instance, the negative emotion *fear* evolved as a mechanism to increase the probability of survival of a being. Further it was also suggested that facial expression facilitates in making judgments on whether a person is friendly or hostile. There have been many such theories on emotion each varied in their ways of explaining its use and generation.

Researchers have always wondered as to whether robots should exhibit such a complex, almost incomprehensible and seemingly non-logical phenomenon. Many have tried their hand at embedding emotion – especially using changes being reflected on a robotic face. Brazeal et al.[2] describe a robot that can emote using a robotic face while interacting with human beings. Decision-making on part of robots has also been governed by emotions[3]. Raıevsky et al.[4] have shown how emotions can affect decisions made by a soft-bot. Emotive robots have also found their use in therapeutics. They have been known to assist those suffering from dementia, Alzheimer's disease and autism. All these seem to somehow motivate us to embedding emotions into machines so as to increase their adaptability, use and performance.

At the Robotics Lab. of the Department of Computer Science & Engineering, Indian Institute of Technology Guwahati, (www.iitg.ernet.in/cse/robotics), we have currently developed a multi-agent emotion engine[5] as depicted in Figure 1, capable of generating artificial emotions in a way akin to their biological counterparts so that they can be used for robot control applications. Rather than call them as synthetic or artificial emotions we prefer to designate them as an *emotional control juice*. Each individual agent represents and dedicatedly generates a given emotion. Positive emotion generating agents suppress their counterparts (viz. the negative emotion generating agents) while stimulating those of their own kind. Negative emotion generating agents do likewise. The complex tussle between this set of emotion generating agents, governed by numerous dynamic equations executed by these agents in parallel, results in the generation of a set of synthetic emotions along with an internal mood. Several other processes running concurrently within the engine, aid in making these synthetic emotions to vary in a manner similar to their biological counterparts. A life-time for stimulations and suppressions, an emotion look-back factor, emotion decay and more importantly an *emotional resource* render the much needed natural and dynamic effects to the synthetic emotions churned by the engine. The engine conforms to almost all the guidelines[6] proposed for modelling emotions.

We are currently in the process of embedding this emotion engine on a real robot situated in an artificial-life-like environment to enable us to explore and comprehend the possible advantages of emotion based control over traditional control paradigms.

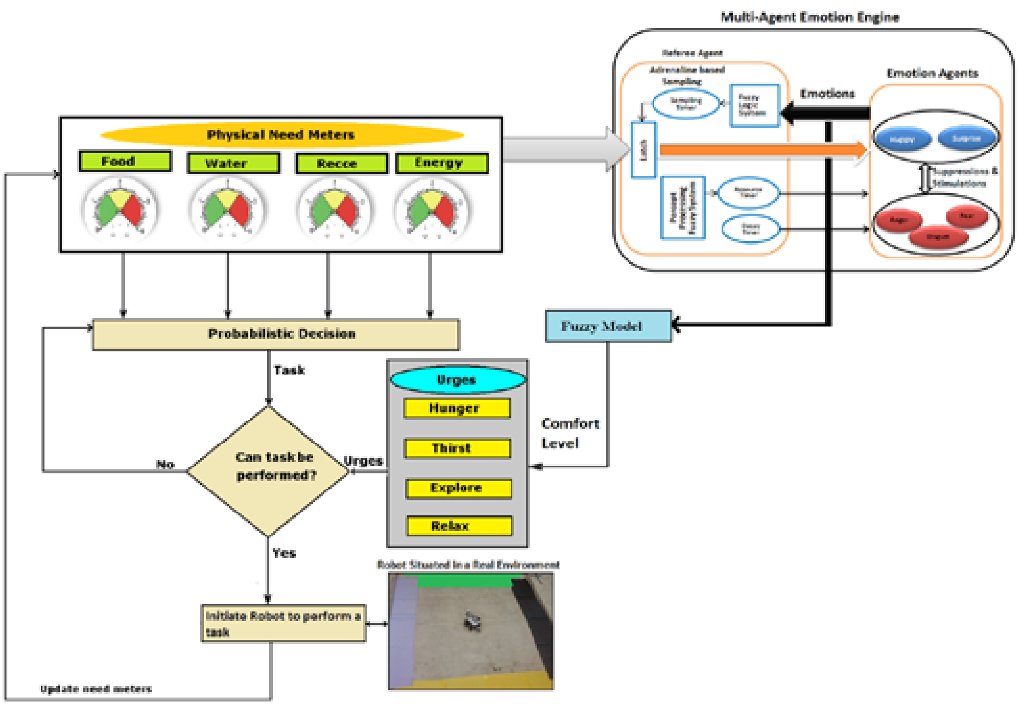


Figure 1 The Multi-Agent Emotion Engine Controlling a Robot situated in an environment.

Robotics and Mechatronics Activities in Bengal Engineering & Science University, Shibpur

Subhasis Bhaumik,
School of Mechatronics & Robotics, Bengal Engineering & Science University Shibpur, Howrah – 711103, West Bengal

Mechatronics and robotics is one of the most promising and emerging trend in technological world which deals with synergistic and multidisciplinary approach in developing new ideas and products. Interests as well as challenges in this particular field is varied and diversified which makes the subject more appealing in solving product oriented problems. School of Mechatronics and Robotics in Bengal Engineering and Science University, Shibpur is a pioneer institute excelling in the area of mechatronics and robotics and offers M.Tech in mechatronics in collaboration with three CSIR laboratories namely CMERI Durgapur, CEERI Pilani and CSIO Chandigarh. Some of the present contributions of School of Mechatronics and Robotics are described below:

Sensor Integrated Multifingered Dexterous Hands: A four fingered robotic hand has been design and is under development which can be controlled by an operator from a remote location through a sensor integrated glove (data glove). The hand has been designed according to actual human hand dimension and has a total of 12 DOFs. The robotic hand is intended to be used for handling objects that are normally not accessible to human beings or are of hazardous nature. Some alternative methods for tracking the operator hand motion is being thought of using machine vision.

Motion Planning of a Bio-mimetic Earthworm: Development of a bio-mimetic earthworm and its motion planning through helical / bend tube (invasive surgery -endoscopy).

Blimp for Aerial Surveillance: The aim of this work is to develop a mathematical model on the buoyancy force and dynamics of the spherical balloon filled with gas lighter than air such as helium, hydrogen or acetylene in external environment in order to derive the control technique for an autonomous spherical blimp having self stabilizing techniques with suitable sensors (camera, gyro, GPS etc.) using proper control algorithm to control the propellers and thrust direction and have a real-time wireless connectivity with the base station to transmit the information gathered.

Active Ankle Prosthesis: Active ankle prosthesis is basically a myoelectric controlled device. Ankle part is mimicked by a servo motor which besides providing actuation also ensures spring like behavior inherent to natural ankle. Sensor fusion technique is used which helps sensor redundancies to be exploited in the design. Sensor unit comprises of EMG sensors, inertial sensors like accelerometer and gyro meter, pressure sensor, foot switch, joint angle measuring sensors. Servo motor serves as actuator unit.

Multisensory Gait Analysis System: Design approach for the multisensory gait analysis system body dynamics is basically integration of different sensor exploiting their redundancy and proper fusion technique. Sensors integrated includes EMG sensors, inertial sensors, different pressure sensors and sensors for measuring body and gait parameters. Kinematic and dynamic model of human body is studied for stability, balancing and judging issues related to gait abnormality.

Multifinger Micro Gripper: The gripping device is capable of manipulating micro objects including biological cell. The gripper is made of polydimethyl siloxane (PDMS) which is a biocompatible silicon rubber and is actuated by IPMC.

Collaborative mapping using UGV's and UAV's

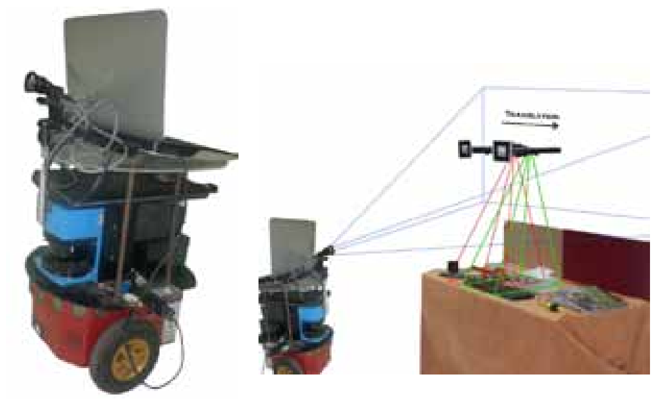
Nikhil Soni, Aravindh Mahendran *-Robotics Research Center, IIIT-Hyderabad, India.*

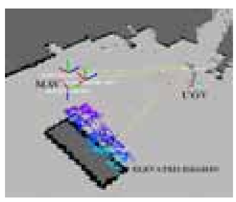
Mapping of indoor environments is a widely researched problem and a variety of sensors are used for this, most commonly, sonars , laser scanners and more recently monocular and stereo cameras. Laser scanners provide dense information and result in accurate 2D maps with exact scale. 3D laser maps can be obtained using pan-tilt units which are rather expensive. On the other hand, monocular cameras are inexpensive, light weight and have been used to obtain 3D maps. Monocular SLAM techniques, however, suffer from a few inherent flaws, namely: 1) a sparse point cloud resulting in sparse information about the map, 2) The map is built only up to a scale. To overcome their individual limitations, have shown how these two sensors (camera and laser) complement each other and how a joint system, with both the camera and the laser placed on a ground robot, could be used to create 3D maps with greater accuracy and scale. Ground robots are, however, restricted to move only on the ground thereby limiting the mapping process to the areas which are accessible by ground, leaving out elevated regions such as tables. Therefore, completeness or comprehensiveness of the indoor mapping process is not guaranteed when using just ground robots.

Over the last 2-3 years, a lot of active research has been done on quad-rotors, both in the field of control theory as well as implementing various SLAM techniques. Mounting lightweight and inexpensive monocular cameras on quad-rotors for VSLAM based approaches has allowed them to create much more comprehensive maps (covering both ground and elevated areas, thereby addressing the problem of completeness). However, these techniques do not provide maps to scale. Also, most VSLAM techniques result in a sparse point clouds and therefore less information as compared to laser based maps. More recently, people have used fusion of IMU data with visual data on a quad-rotor for accurate scale estimation using an extended Kalman filter. But their work is based on Klein's Parallel Tracking And Mapping (PTAM) and hence is limited only to small AR spaces. Hence we conclude that to the best of our knowledge, there is no method to build comprehensive 3D maps which are accurate, dense and retain scale.

We attempted to solve the problem of accuracy and scale up to a certain extent by presenting a novel system which consists of two robots with different capabilities, working in a collaborative manner. We placed a heavy laser scanner on an unmanned ground vehicle (UGV) and a much lighter monocular camera on a quad-rotor or Micro aerial vehicle (MAV). In our system, the ground robot is used to create dense 2D maps of the ground using the laser scanner. The MAV carries the monocular camera and moves over certain areas which are inaccessible to the ground robot (like tables or other raised areas which are marked as obstacles in the 2D map). It creates 3D point clouds of these areas. Thus, the MAV acts as a mobile sensor with greater agility than the ground robot. The augmented map thus produced (consisting of a 2D map of the ground built by the UGV and 3D maps of areas covered by the MAV) is much more comprehensive.

To solve the problems of scale mentioned earlier, we impose a restriction on this two agent system: while the MAV creates a map, the UGV (the 3-dof pose of the UGV is known up to a certain accuracy) should be able to track the MAV in 6-dof, so that the MAV's camera's pose can be estimated and in turn the scale of the resulting map be determined. We use a monocular camera on the UGV to track square AR-markers placed on the MAV; hence the MAV must lie in the field of view of the UGV's camera while mapping. So as long as the UGV is able to track the MAV, scaled point clouds can be built. This leads to comprehensive augmented maps to scale, 2D in some places while 3D in others. The complete system was developed using the Robot Operating System (ROS) as it provides an apt platform for setting up such a collaborative system.





The picture to the lefts shows the resultant augmented map (the grey region being the 2D map and the blue-purple point cloud being the map of the elevated region). The picture below that shows the top-orthogonal view of the map, depicting how the point cloud is aligned with the unknown region in the ground map.

RoCK-BEE: An Experience with ROBOCON

Subir Kumar Saha, IIT Delhi, India

In this article, I will explain the concept of "Robotics Competition Knowledge Based Education in Engineering" (RoCK-BEE). In last one decade, there has been a sharp increase in the engineering institutions in India that has given rise to enhanced student enrolments. However, it is unfortunate to read in many reports that only about 25% of those graduating (~ 5 lakhs) every year are employable. This is certainly not desired, particularly, when the country has started adopting automation for its technological enhancements. India will be requiring skilled manpower not only in terms of workmanship but also with fundamental knowledge. Hence, I have initiated the concept of RoCK-BEE in 2007. Note that since 2003 the UG students of IIT Delhi have started participating in a robotics competition called ROBOCON under my guidance. ROBOCON, an acronym for ROBOtics CONtest, has been initiated by Asia-Pacific Broadcasting Union (ABU) in 2002. Doordarshan (the national television channel of India) as a member of ABU organizes ROBOCON in the country. The winning team of the Indian ROBOCON represents the country in the ABU contest. India hosted the 2008 ABU-ROBOCON in Pune, whereas IIT Delhi as a national winner of 2007 competition represented India in Hanoi, Vietnam. A typical robot used during ROBOCON 2011 is shown in Fig. 1.

While guiding the ROBOCON students to design and fabricate robots I realized that the skills of the students were getting enhanced. However, as an engineer or technologist should they remain at that level or they should be doing more. Certainly, as graduates they should have the knowledge of why they would be doing in a way they were doing. Otherwise, there would be no difference between a mechanic or an electrician and an engineering graduate. Hence, I have decided them to have the following characteristics in their style of working during their ROBOCON preparations and afterwards:

1. Maintain project diaries to capture their thought processes like any good designer/professional.
2. Work in a group and identify specific responsibilities for each one in the group.
3. Have engineering drawings (be it mechanical or electrical or anything) before fabrication starts.
4. Practice good assembling processes based on existing literature or with the advice of an experienced person.
5. Keep a record of the faults and necessary corrections during the testing of the robots so that those records become a valuable lesson for the students of next year's competition.
6. Write a report on the design and the experiences during the competition so that it helps the next batch of students.
7. Maintain the record of the suppliers, purchases, expenses, etc.
8. Later, after the competition was over, if somebody was interested to do any academic project, I have encouraged him/her to take up one related to ROBOCON.
9. In the academic projects, students were encouraged to find reasons for any failure occurred during the competition based on their theoretical knowledge gained in one or more of the courses at IIT Delhi.
10. In some cases, students were asked to develop a tool/software based on the knowledge gained during the courses so that even first-year students could perform a design activity prior to the exposure of higher-level courses.

In a way, all aspects of an engineering company were experienced by the students. Hence, they become industry-ready who can REALLY serve the organization with quality. Since the word "robot" attracts the young students, its design, fabrication, programming, testing, etc. to perform certain tasks as per the rules of a game (as specified by the organizer of a competition) expose the students to a variety of subjects and forces them to assimilate the knowledge to successfully develop of a product (in this case robot). Hence, the objective of the technical education is fulfilled in true sense.

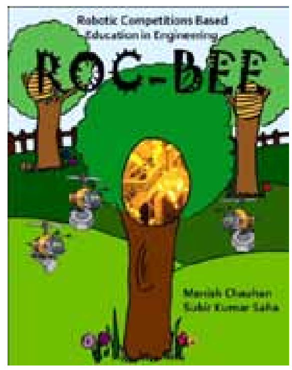


Fig. 1 A robot during ROBOCON 2011 Fig. 2 Cover page of RoCK-BEE book

Moreover, with the increasing number of student enrolments and proportionally decreasing number of faculty (not counting them though!) in the academic institutes, it seems only feasible that the students learn themselves. Hence, the concept of RoCK-BEE appears to be an effective tool towards that direction. Here, the word "competition" is important as it sets a goal for the students without any possibility of self manipulation, which typically the case during many academic projects.

In order to share the above benefits, I started the lecture series in 2007 which has been already delivered in India and abroad 46 times. Besides, a fiction was written with the help of an ex-student which is available online (http://pothi.com/pothi/book/manish-chauhan-rock-bee). See its cover page in Fig. 2. For any comment, please contact me by email: saha@mech.iitd.ac.in.

Remotely Operated Submersible

Mohanachandran R, James Abraham, Janardhanan Nair K, Dinesh Kumar K,

Joby Thomas, Harikrishnan C S

Strategic Electronics Group, Centre for Development of Advanced Computing, Thiruvananthapuram, India

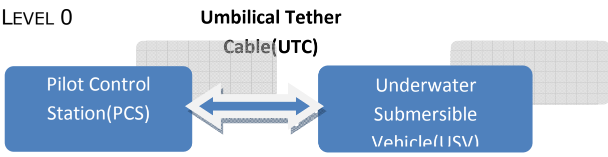
Objectives : Design and Develop an underwater ROS, which can be controlled by a pilot located above water. The Pilot's Control Station (PCS) will be connected to the Underwater Submersible Vehicle (USV) by an Umbilical Tether Cable (UTC) to carry power and navigation commands from control station to USV, and video pictures and data from USV back to the PCS.

I. Features: USV is capable of :

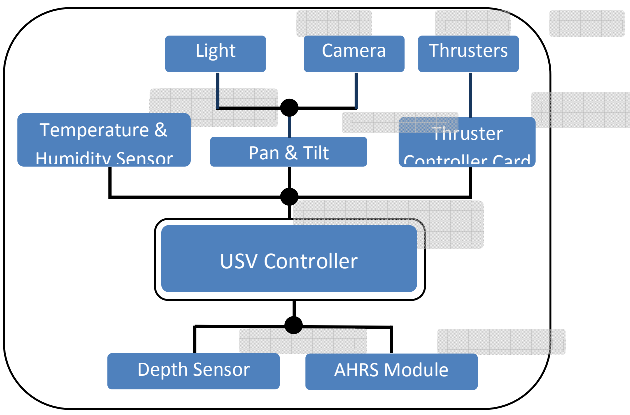
- Moving in Forward, Backward, Port, and Starboard directions.
- Rotation in clock-wise and anticlockwise directions in the horizontal plane.
- Dive underwater and hover at a particular depth.
- Maintain the set Heading in horizontal plane in AUTO mode.

BLOCK LEVEL REPRESENTATION

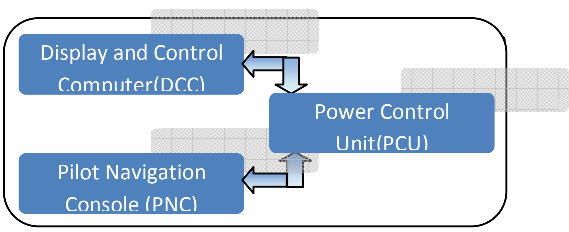
A. LEVEL 0



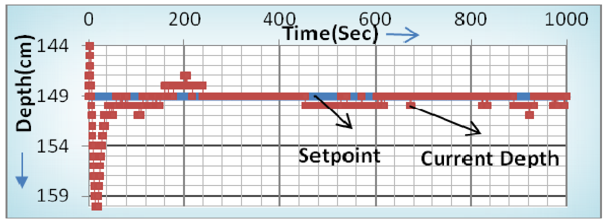
B. LEVEL 1 – USV



C. LEVEL 1 – PCS



II PERFORMANCE OF ROS IN AUTO DEPT MODE



III. USV at a GRANCE (FRONT AND BACK)

IV SPECIFICATIONS

Operating depth	: 30m
Speed along,	
Longitudinal Axis	: 1.0 knot
Transverse Axis	: 0.5 knot
Total payload of USV	: 17.85kg
Additional Lifting Capacity	: 4.5 kg

	Conferences:	Dates	Place	Due
1	12th IEEE-RAS International Conference on Humanoid Robots (Humanoids 2012)	29 Nov - 01 Dec 2012	Osaka, Japan	22-Jun-12
2	First RSI/ISM International Conference on Robotics and Mechatronics Conference	12th to 14th February 2013	Tehran, Iran	22 June 2012
3	IEEE international conference on Mechatronics	Feb 27-28, March 1 2013	Vicenza (Italy)	30-Jun-12
4	IEEE International Conference on Robotics and Biomimetics (ROBIO)	11 Dec - 14 Dec 2012	Guangzhou, China	15-Jul-12
5	IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2013)		Tokyo, Japan.	
6	ICRA 2013: The 2013 IEEE International Conference on Robotics and Automation	May 6, 2013 - May 10, 2013	Karlsruhe - Germany	17-Sep-12
7	2013 IEEE/ASME International Conference on Advanced Intelligent Mechatronics	July 09 2013 - July 12 2013	Wollongong , Australia	
8	IEEE SSCI 2013, IEEE Symposium Series on Computational Intelligence	15th to 19th April 2013	Singapore	10th Nov 2012
9	2013 IEEE Workshop on Advanced Robotics and its Social Impacts (ARSO)	7-9 Nov 2013	Shibaura Institute of Technology, Tokyo	1 May, 2013

JUST ROBOTIC FUN !

Prof. Gyro and Tale of Robotail

(Soumen Sen, CMERI, Durgapur)

Professors's Gyro's new machine is so fantastic,
Everybody in the civilization is raving about it.
Ever sceptic Prof. Gearloose even leaves his rivalry,
Says, "Our Gyro has won the Robotics' greatest glory!!"
On sheer creative power has Gyro made his gadget –
Does everything by waving its tail, made at a very low budget.

When Gearloose saw the gizmo, with grave and peevish mind,
After half-a-day detailed scrutiny, said, "I do not understand the theory behind !"
Be it any locomotion or propulsion or flying in the air,
The tail, switching from mode to mode, uses neither linkage nor any gear.
There exists no slip, nor is the locomotion non-holonomic,
At the height of ingenuity, Gyro explains everything is ultrasonic.

When it swims, the tail spatially undulates;
Lift, thrust and drag, the new hydrodynamics dictates.
It beats, it flaps, it rows in reaching the goal –
Gyro says, "In the propulsion, water does not play any role."
When the machine flies, do not try to find there a wing.
All you will see in the blue, a long tail swings !!
It is not a butterfly, and nobody says it a raptor –

Known aerodynamics cannot explain what you learn in the university chapter.
Conservation of momentum is still valid, when it takes off for the Moon,
But you won't find any exhaust, where fuel burns out very soon.
No fuel to carry, no plugging in the charger,
Gyro genious has made its surrounding the sole energy supplier !!

With the mechanism and motor it has an intelligence embedded –
Cognition, perception, autonomy, it gets all the advantages added.
How to describe the thingamajig, I do not find a word to say,
Come yourself to Robotpur, not believing only in hearsay.
With Prof. Gyro, aka Naveenchandra Aviskarak, do you want to meet?
Arrive at Robotpur after twelve noon, with a big pack of sweet.
And, do not forget to be a member of the Indian Robotics Society –
Find its Newsletter depicting everything of Robotail, the mighty.


Robotic rickshaw


I declare you husband and wife


Who are you?