Vol. 9, No.1 June, 2021

# THE ROBOTICS SOCIETY

# NEWSLETTER

## AT A GLANCE..



## ANNOUNCEMENTS

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## A report on the TRS Workshop 2020 @IIT Ropar

TRS biennial workshop 2020 had been planned to be hosted at IIT Ropar campus, but due to Covid-19 situation the workshop was scheduled for online mode. The five days event was sponsored by AICTE, and was scheduled on November 2-6, 2020. Inaugurated by TRS Secretary Prof Asokan Thondiyath and by IIT Ropar Director, Prof Sarit Das, the workshop was convened by Dr Ekta Singla, IIT Ropar. Around 250 participants from different parts of the country actively participated online. There had been ten distinct sessions conducted in a well-arranged sequence, and speakers of the workshop were national and international researchers including Prof Ahmed Chemori, CNRS, France, Prof Giuseppe Carbone, UNICAL, Italy, Prof Asokan T., IIT Madras, Prof Subir K. Saha, IIT Delhi, Prof Ashish Dutta, IIT Kanpur, Prof Pushparaj M Pathak, IIT Roorkee, Mr Alok Mukherjee, R & DE Engg, DRDO Pune, Prof S. Bandyopadhyay, IIT Madras, Prof Ashish Singla, TIET, Patiala and Prof Ekta Singla, IIT Ropar.

The workshop included the fundamental topics spanning from kinematics, dynamics and control, integrated with practical aspects and challenges. Commenced by the session of Prof T. Asokan on detailed description on forward kinematics of industrial robots, the day-1 program included another session from Mr Alok Mukherjee, DRDO Pune, on Robotic realization. The balance of the theoretical aspects and corresponding realization details had been appreciated by the participants to a great extent. On day-2, the aspects of inverse kinematics and kinematic analysis had been covered by Prof Sandipan Bandopadhyay and Prof Ekta Singla respectively, and their sessions were followed by design details and practical challenges on mobile manipulators by Prof Pushparaj Pathak. The rhythm had been continued on day-3 through other rich sessions from Prof S. K. Saha and Prof Ahmed Chemori on Dynamic aspects and motion control. Prof Saha also emphasized on the practical experience gain through robot competitions and other such platforms.

A large coverage of controller applications in several types of robots - presented by Prof Chemori had closed the third day with big motivation to many participants. Dynamic aspects discussion had been continued on day-4 through the session from Prof Ashish Singla.

**"How to become a TRS member ?"**

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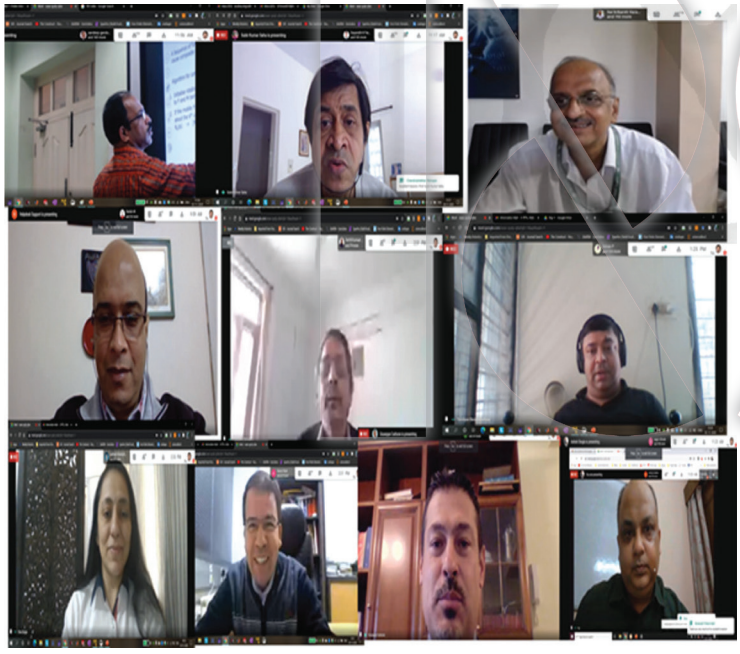
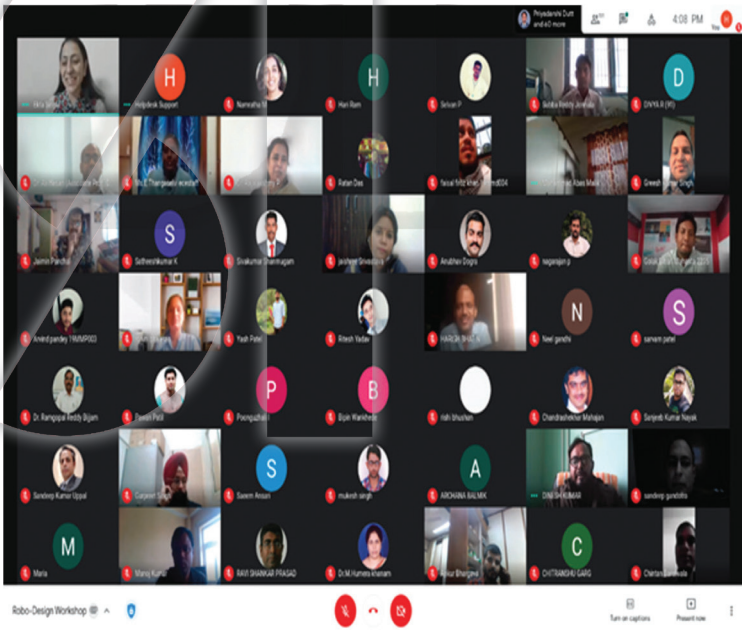
**http://rs-india.org/membership/**

The session for the day was concluded through the practical works discussed by Prof Giuseppe Carbone. One of the achievements of the five-day workshop is that the enthusiasm and the participation had been sustained till last session. The fifth day included design and control aspects of robotic applications in arm and leg exoskeletons by Prof Ashish Dutta, and another practical session on military robotics by Prof Alok.

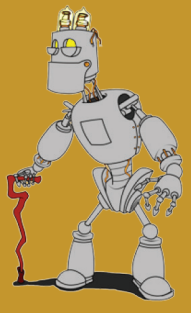
On the final session a quiz was conducted to evaluate participants on their learnings – which had been a mandatory feature in AICTE scheme. Feedback was mandatory for each participant and a huge set of good remarks had been received from all participants. One session on ROS learnings had also been arranged as a tutorial for all participants to get motivated. Few of the screenshots including speakers and participants are included here for reporting the online nature of the program. Communication to Participants was done through well defined regular mails – as Information mails 1-7. This was liked by all the participants as this had lead to no communication gap. Another acknowledged aspect was the uploading of the course contents without any delay. The talk videos, PPTs and chats were uploaded in the folder – along with the attendance of the day. Overall, the feedback of the participants was marvelous, which is a big achievement in a program with such a large gathering!





## ELEKTRO

Elektro, a creation built and showcased at the 1939 World's Fair, is considered the oldest surviving robot in the world. Elektro robot is programmed to talk and consists of 48 electrical relays which operate similar to a telephone switchboard. The robot takes voice commands via a telephone handset, enabling it to respond to commands. It is currently showcased at the Mansfield Memorial Museum, USA.



# ROBOTICS ACTIVITIES @ CENTER OF INTELLIGENT ROBOTICS IIIT-ALLAHABAD

**Brief History of the Center:**

Robotics teaching and research activities started as one of the oldest research laboratories of the institute which was developed by Prof G. C. Nandi in the year 2001. Subsequently, attributed to significant research, and activities, the robotics group was uplifted as a Center of Excellence named Centre of Intelligent Robotics with special emphasis on Health Care Automation. Presently it is one of the premier Robotics centres in the country which is imparting quality teaching, research and training activities. The centre is equipped with state-of-the art infrastructure including Baxter humanoid robot (Cobot), Nao humanoids, Pioneer LX mobile robot, etc., along with a bouquet of indigenously developed robots. The centre derives its strength from collaborations from leading international and national academic institutions and industry partners.

**Recent research Activities of the Centre:**

**1. Optimized Real-Time Multimodal Emotion Recognition by Humanoid Robots**

Recognizing human emotion is a complex problem in the sense that humans themselves might be wrong in predicting other person's emotional state of mind all the time. So, when it comes to robots recognizing human's emotional state of mind, its complexity increases manifold. Above all, when a person is happy might not always be smiling and an angry person might not always scowl. So, to predict human emotion, facial expressions are not the only metric to make the right prediction. Taking this into consideration, we are currently exploring facial expression, context (everything other than face), audio and text modes to predict emotional state of mind. Each mode of communication is first optimized and improved and finally a fusion model has been built to make the prediction in humanoid robots.

**In our recent research, we are considering the ways to improve the performance of each of the following modes:**

- Facial expression – Inception based optimized model with Global average pool to reduce computation. robust model is built and tested over 8 different datasets, Attention mechanism to blur out non relevant parts of an image and zoom in the relevant areas. Performance is improved over state-of-the-art models.
- Audio – Double model is built for audio – one through extracting MFCC features and training a Conv1D model, and other by plotting image of spectrogram of audio and extracting pattern out of it for different classes, which out performed the state-of-the-art models.
- Text – Attention based LSTM model to predict classes in emotions.
- Fusion function- Finally while fusing all the models of communication, the fusion function itself is learnt with training, to check the weights as in which mode will contribute by what factor to predict the final result.

**Recent Recognitions:**

i. CVPR- 2019, June 16-19, 2019, Long Beach, CA, USA.
ii. Image based Emotional State Prediction from Multiparty Audio Conversation, in the proceedings of IEEE PUNECON 2020, December 16-18, 2020, Pune, received best paper award.

**2. Intelligent Grasp Manipulation**

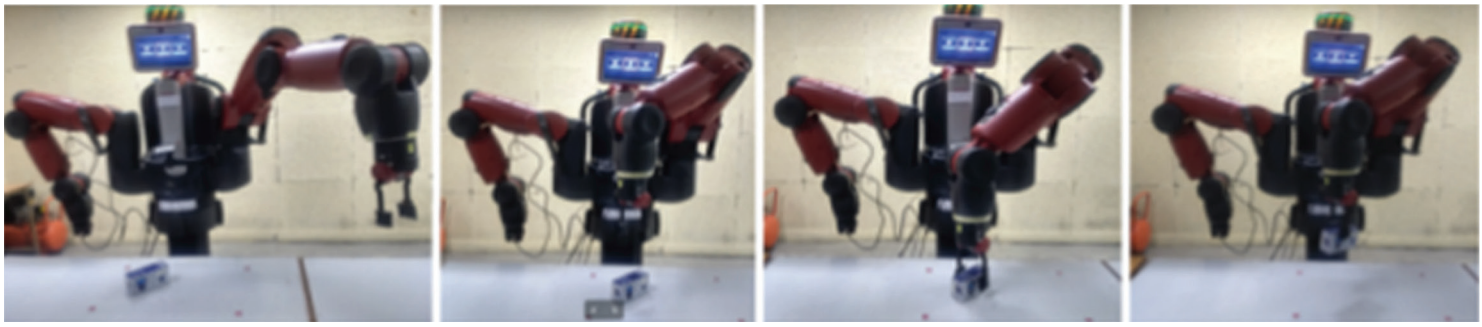
Making a robot capable of manipulating objects in a dynamically changing real world environment skillfully, the way we do, is extremely difficult. It turns out that for us also the object manipulation through grasping is challenging and it requires substantial learning. A child generally has a poor skill of grasping and thus they are normally not allowed to manipulate sophisticated/fragile items. But over the years, through training, kids grow skill and learn how to grasp objects with various shapes and sizes appropriately, making a grown up person capable of handling those items safely. Imparting such skill to a robot, although required, is extremely challenging due to the non-availability of sufficient training data, since for making a robot capable of learning from experience, huge amounts of quality data are needed. We are doing extensive research in this area:

1. We have recently developed learning-based robot gripper pose estimation by decomposing the problem into both position and orientation learning which uses a genetic algorithm based optimization technique for predicting correct gripper position and reinforcement learning for gripper orientation learning with the previously tried attempts either they are successful or failure during execution.

2. We are working on grasp pose estimation with the limited labelled data in a semi supervised fashion. Moreover, we have tried to solve the data scarcity problem with the help of generative models to learn with limited labelled data and by generating more labelled data to train a new model. For grasp execution verification, we have two manipulator robots in our laboratory, Baxter (named as Anukul) Research robot and Locobot.

**Recent Recognitions:**

i. IEEE CVPR 2020, June 16-18, 2020, Seattle, USA (online).
ii. Robotic Grasp Manipulation Using Evolutionary Computing and Deep Reinforcement Learning, International Journal of Intelligent Service Robotics, 2020.



Baxter is trying to learn from failure using deep reinforcement learning
(https://www.youtube.com/watch?v=T0NAMvuaWcY&list=PLFWlHcAOSQbp88sEzqCh15MN-tilkWS4E)

**3. Human Motion Prediction using Adaptive Sampling-Based Architecture**

Human motion prediction has been used in various fields such as for action recognition, human tracking, graphics and gaming, autonomous vehicles etc. To avoid an expected collision in a crowded street robot should have the capability to predict the pedestrian movement by observing the past motion. We developed an adaptive sampling based cost function to train the network architecture. Our network has a Gated Recurrent Unit based encoder-decoder architecture. This adaptive function filter-out the outliers data during the training. It reduces the computational cost of training. We use a sampling-based concept to make the network capacity to learn from its own mistakes. This adaptive cost function gives a better performance than the mean squared error cost function.

**Recent Recognition:**

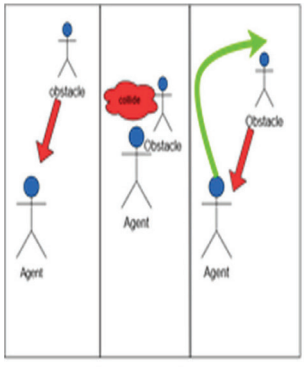
i. Development of Adaptive Sampling Based Strategy for Human Activity Predictions Using Sequential Networks, in the Conference proceedings of IEEE, Information and Communication Technology (CICT), 3-5 December, 2020 (Received Best Paper Award in the track of Artificial Intelligence and Machine Learning)

**4. Learning-Based Reactive Navigation of the Robot**

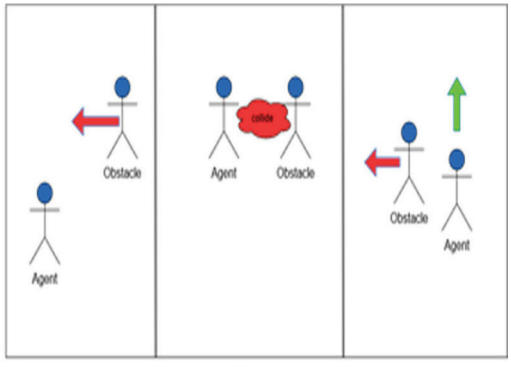
Motion planning of mobile robots in a dynamic and unknown environment is a challenging problem and the classical approaches have mostly failed to address this problem. This problem of motion planning has been open for decades and no effective solution has been proposed. However, humans intelligently avoid dynamic obstacles, the behavior of avoidance motivated to incorporate in the motion planning of a mobile robot. Machine learning can now be used to collect data of how humans move, which is learnt by the robots. The only problem is that there could be tons of behaviors possible. The understanding of human's avoidance is quite complex, on contrary if we approximate the behavior, it seems in 90% of the cases are used for only two behaviors i.e., head on collision avoidance (obstacle comes from the opposite side of the agent and hits the agent) and 'stop and move' behavior, while the rest of the human behaviors are not important for the robots. The head-on-collision avoided by taking either left or right turn and stop and move gives time to the obstacle to cross the agent path. The same behavior is incorporated in mobile robots using LSTM-based deep learning models and the agent is equipped with the model to apply the same behavior on the input of 2D LiDAR raw data of the environment. The proposed algorithm outperforms the two state of the art algorithms TEB (Timed Elastic Band) and DWA (Dynamic Window Approach). This research to mimic the behavior does not stop here, to make the approach more feasible, we are working on a reward function using the inverse reinforcement learning. In supervised deep learning the likelihood of incorrect training is very high, similarly in the reinforcement learning it is not necessary, your best policy will generate the best reward. These two drawbacks motivate us to find the correct reward function for individual behavior of obstacle avoidance.

**Object Based Semantic Mapping for Human Robot Interaction in a Household Environment:**

In the growing world of IT, smart homes are becoming popular which requires smart control over appliances, services, and comfort in a home environment. We are working on robot functionalities which can be easily governed smartly, either by using some gesture and voice based direct commands or by using state of the art virtual assistant like Alexa, Siri, and Google Home. For easy application on robot, we are working on object based semantic mapping of the indoor environment, which gives an ease in navigation of robot and manipulation of household objects. We work on object detection algorithms, motion sensing algorithms, and monocular depth estimation.



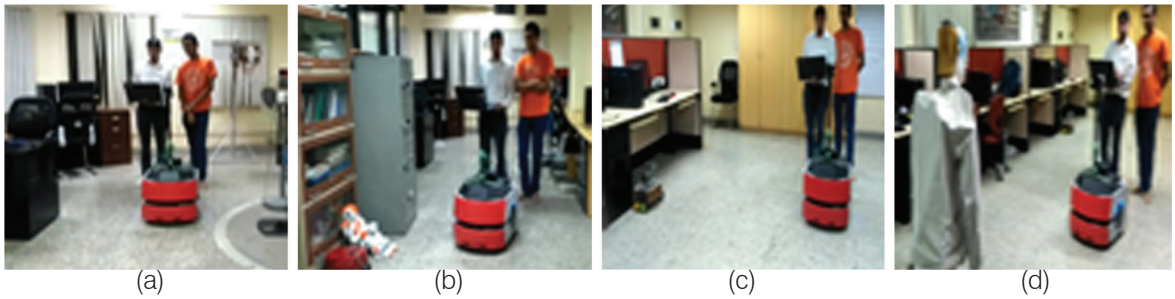

Head-on Collision Behavior




Stop and Move Behavior

**Navigation with Cooperative Social Robot**

The research in robotics has led to a widespread adoption of robots for numerous applications, operating in environments like laboratories, corporate offices, universities etc. The modern day robots can do a variety of tasks with great efficiency, however their utility is limited due to the non-social behavior of the robots. For the same it is important to assess the human behavior in diverse conditions so as to eventually make robots socialistic in nature. Hence, we have presented a novel robot navigation methodology which is based on Behavioral Finite State and Social Machine (B-FSM).



(a) (b) (c) (d)

Fig.2 Robotic tour (a) Robot at its initial state and is ready to start its tour (b) All visitors are detected behind the robot (c) Robot reaches fourth vising site where Tinku, a socialistic robot is present (d) Robot reached at its last vising point and SMART robot was located here. The robot terminated.

Recognitions:

i. V. Malviya, A. Reddy, R. Kala, R. (2020). Autonomous Social Robot Navigation using a Behavioral Finite State Social Machine. Robotica, 38(12), 2266-2289.

ii. A.K. Reddy, V. Malviya, R. Kala (2020) Social Cues in the Autonomous Navigation of Indoor Mobile Robots. Int J of Soc Robotics (2020). https://doi.org/10.1007/s12369-020-00721-1

iii. V. Malviya, R. Kala (2021) Trajectory Prediction and Tracking using a Multi-Behaviour Social Particle Filter, Applied Intelligence.

## ONLINE LECTURE SERIES BY THE ROBOTICS SOCIETY

In the times of COVID-19 and Lockdown, the academic learning and research has taken a hit. To ensure the robotics research progresses, TRS has planned Online Lecture Series.The webinars in this series were planned and held as detailed below. All the webinars were open for the members of The Robotics Society and also for general public. More details about the registration and detailed information about the webinars can be found at http://rs-india.org/online-lectures/ . The videos recorded during the webinars are available on the above website and are also available on the YouTube channel of TRS at https://youtube.com/channel/UCLL8oRHXKPZf3q10dkIBqlg

# ROBOTICS ACTIVITIES @ RAE,PSG-TECH, COIMBATORE

**Product Development Group – Robotics and Automation Engineering (PDG - RAE)**

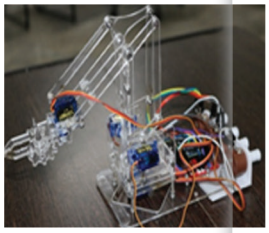
Our Research and Development Group incorporates engineers from different industrial domains and Professors of Robotics and Automation Engineering Department with expertise in the domain of mechanical, electrical, electronics and computer science. We are working towards a common goal in the development of Industrial Robots, Educational Robots and Drones for various applications.

**Industrial Robot**

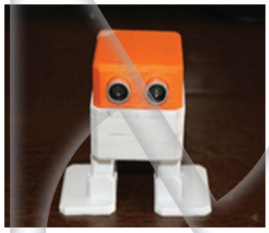

Articulated Robots are in use across the globe in industries, research institutions and educational sectors to achieve organizational goals. The need of robots in day-to-day life is getting increased at a gradual rate. So, it is important to learn and analyze the applications of the robotic arm used across industries in order to get an idea of what does an industry or a customer actually requires. On analyzing the need of the market, we designed and developed a 2 kg payload robotic arm with an open-loop chain for industries and can be a learner kit in educational institutions. The developed robot is used for vision-based path generation for minor welding of components. The highlight of the robot is an Arduino mega controller which reduces the cost of the robot that makes it economical for the end-user. The robot is user-friendly, easy to set up and operate.

**Educational Robots**

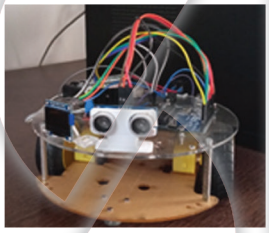
Educational robots helps in basic study and understanding of design, analysis, mode of operation and application types. Educational robot includes differential type mobile robot, biped robot and articulated type robots. These types of educational robotics can be taught from school level to graduation level as per standards. Our product development on educational robots are shown in figures below.



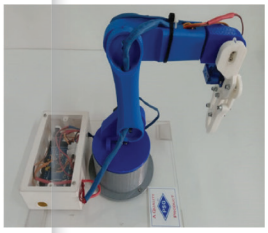
3+1 Degrees of Freedom (DOF) Claw Kit



PSG Edubot



Differential type mobile Robot



5+1 DOF Robotic Arm

These are very simple and easy-to-build kit, it is the perfect Arduino Project for children and beginners and great learning platform to get into Robotics Engineering. The Robot Arm comes with a flat pack for assembly and requires minimum effort to get assembled up and running. The servo system allows 4 Degree of motion and can pick up 20gram items with the claw. Arms control can be performed by potentiometers.

A mini biped-type robot developed with a fair epic charisma. It is a mini-humanoid robot that tends people to come closer to the technology by hands-on making. In doing so they learn about the logical connection between the mechanical components, design, electronics, and programming. Child-friendly block and syntax-based programming can create your program to play with the bot.

The mobile robot is controlled by open-source software using sensors and technologies to identify the working environment and move according to the Static obstacle available without obstructing. The mobile robot comprises software and physical element of DC geared motor with wheels for its movement. It can be controlled using an Android application with the help of a Bluetooth module available in the mobile robot. It can be updated to newer versions depending on the application.

The 5+1 DOF Robotic Arm is a real time control using Robotic Operating System(ROS) with Linux environment. It's an activity based Do-it-Yourself (DIY) assembly kit with Arduino Controlled servo motors. To understand the ROS components this robot is developed with visualization of arm movements in both physical and simulation mode by joint state publisher and robot state publisher components.

In Japan, the percentage of people above the age of 65 is expected to reach 40% by 2065, making almost half the population elderly. This implies the need for a reliable solution of medical care for them, and as a result, the nursing-care robots market is currently booming in Japan. With almost one-third of their government budget spent exclusively on developing care robots, the country is set to become a haven for elders in the world.

**TRS student chapter**

To know the guidelines for the formation of TRS students chapter in your institute

**visit: http://rs-india.org/student-chapter/**

An android application based contactless temperature screening kiosk for measuring the abnormal temperature of the visitor at the point of admittance was developed. This kiosk has facial detection with voice based interaction technology. Thermal sensor is used to detect the forehead temperature, based on preset rules of allow or deny access, alerts are displayed on the screen along with audible voice alarms, which can also be customised. Server Software is connected with this kiosk for configuring and monitoring the kiosk for efficient people handling. This device is easily customizable for various avenues with easy mounting and maintenance.

For more details visit : https://drive.google.com/file/d/1r20o5hV5DDzk2HNei_UbXFIaqz8PhyeJ/view

# TRS - STUDENT CHAPTER ACTIVITIES - COLLEGE OF ENGINEERING PUNE

**Inauguration**

The first ever student chapter of The Robotics Society India was inaugurated at College of Engineering Pune on 18th January 2019. Chief Guest for the inauguration ceremony were Mr. Alok Mukherjee (Scientist 'G' and Head, Robotics Division, R&DE Dighi, DRDO) and Dr. B. B. Ahuja (Director, College of Engineering, Pune). Mr. Alok Mukherjee is known for his instrumental work in the development of UAV Netra). The student chapter was inaugurated using an upper torso humanoid robot built at COEP's Robotics and Automation Lab by Robot Study Circle members. This inauguration ceremony received a very encouraging response and it was attended by a number of robotics enthusiasts. At the end of the ceremony, Robot Study Circle Members who represented India at the International Robocon 2017 at Tokyo, Japan were felicitated with Certificate of Appreciation for their outstanding performance at International Robocon.

**Activities conducted by The Robotics Society, Student Chapter-COEP in the year 2019-20**

COEP being the first ever student chapter of The Robotics Society, had organized a series of one-day seminars on various topics related to the field of robotics. In collaboration with TEQIP-3 and Robot Study Circle, which is robotics club of COEP five seminar had been planned.

First seminar was on Robot Operating System(ROS) which was conducted on 15th of February 2020.The guest lecturer for the same were Mr.Havish Bychapur and Mr. Joseph Sherman from FlytBase India pvt.ltd. FlytBase India is a successful startup and they provide drones for various industrial and non industrial projects. Our guest lecturer introduced ROS from the very basics and also demonstrated how coding in ROS can be done. Almost 150 students and faculties from various colleges and institutes took the benefit of the seminar conducted.

Seminar on ROS

Seminar on Industrial Robot programming

The second seminar was conducted on Industrial Robot Programming on 29th February 2020 and the expert lecturer for the same was Dr. S. S. Ohol, faculty Incharge Robotics & Automation Lab, COEP. He has introduced the students with industrial robots and recent trends and developments in the same. A demo and hands on session was also conducted by Miss. Kirti Shahane in which students were able to learn the operation of ABB IRB 1520ID robot and they were given hands on experience on coding of the motion of robot.

A biotechnology startup called Koniku is developing robots that could sniff out Covid-19 infections faster than conventional testing. The technology fuses neurons with a silicon chip to create a "smell cyborg" capable of detecting scents ranging from explosives to pathogens. Small internal trials have already demonstrated that it can accurately detect the presence of Influenza A.

The next programme was an online lecture organized directly by the experts from Mathworks on Robotics and Automation using Matlab and Simulink.The webinar was conducted on two days, 30th and 31st March, 2020 for two hours each. Mr. Pawankumar Fakatkar, Education Technical Evangelist, MathWorks and Dr. Dhruv Chandel, Education Technical Evangelist, MathWorks, delivered lectured on 1st and 2nd day respectivel. Prof. S. S. Ohol, COEP, coordinated this webinar successfully. The topics covered during this webinar are : Modelling a robot link in Simscape Multibody; Forward Kinematics, Trajectory Planning, Modelling a DC Motor using Simscape, and PID Control.

The webinar saw a good response from the students of COEP. For the first session there were 74 participants and for the second session there were 64 participants, those include students of Robot Study Circle, COEP, TRS Student Chapter members, B.Tech Mechanical students pursuing Robotics and Automation (conducted by Dr. S. S. Ohol) as their elective subject and M.Tech students from COEP.

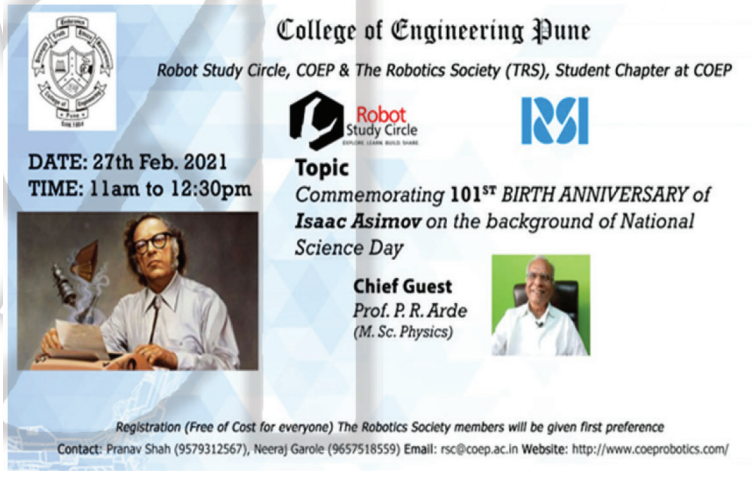
**Activities conducted by The Robotics Society, Student Chapter-COEP in the year 2020-21**

In 2020-21, a series of lectures were organized on various topics such as “Online Industrial Robot Programming Workshop with live demonstration, “Expert Lecture on Humanoids followed by Virtual Demonstration of Nao-VI”, and the most recent one was organized to mark the 101st Birth Aniversary of Issac Asimov on the background of National Science Day.

The “Online Industrial Programming workshop with Live Demonstration” was organized on 26th Dec 2020 and was conducted under the Expert Guidance of Robotics And Automation Team at I-Tech Robotics Pvt Ltd, Pune.

In the ”Expert Lecture on Humanoids”, Dr Shantipal S Ohol, COEP covered the aspects of “Recent inventions in humanoid technology” and then a Virtual Demonstration of Nao-VI was given by Mr. Aniruddha Gaikwad and Mr. Arya Arasan. It was held online on 30th Dec 2020.

On the occasion of National Science Day & the year marking the 101st birth anniversary of Isaac Asimov, a lecture on the topic ‘Isaac Asimov -A Great Author who popularised Science’ was organised in online mode. The lecture was delivered by Prof. P. R. Arde (M.Sc. Physics), who was a professor of physics at Rayat Education Society & is a good writer as well. His writings have received many awards & his work is also recognised by the government of Maharashtra. The lecture was focused on the contribution of Isaac Asimov to the literature and the 3 laws of Robotics stated by him. A total of 150 students and staff from various colleges took benefit from it.


## Advances in Robotics (AIR 2021)

5th International Conference of The Robotics Society
June 30 - July 4, 2021, Indian Institute of Technology Kanpur, Kanpur, India

Advances in Robotics (AIR) is a series of biennial conference organized by The Robotics Society. The conference aims to create a forum to present and exchange new ideas by researchers and developers from India and abroad working in the fields of robotics and its applications. The conference would have plenary talks, oral and poster presentations, and special industry oriented sessions.

AIR 2021, the 5th conference of the series, will be conducted in “Fully Online Mode” by IIT Kanpur, Kanpur, Uttar Pradesh, India during June 30-July 4, 2021. The previous editions of AIR’s were held at R&DE, DRDO Pune (AIR 2013), BITS Pilani Goa Campus, Goa (AIR 2015), IIT Delhi (AIR 2017) and IIT Madras (AIR 2019).

For more details visit : https://advancesinrobotics.com/2021/T