INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
Office of the Dean R&D

Minutes of the Discussion meeting between IIT Bombay and DRDO for setting up a Centre of Excellence in Internal Security at IIT Bombay

Date: 23rd July, 2011
Venue: Director's Conference Room
Time: 11.00 A.M.

Agenda- Annexure-1
List of Participants- Annexure-2

1. Opening Address

Prof. Khakhar Director welcomed the DRDO team led by Dr K Sekhar, Chief Controller, R&D (LIC & Implementation) and faculty members. He briefed the visitors about the initiatives towards internal security like CEP course for police and paramilitary forces on recent advances in technology which can help in operations and investigations and about the various sponsored projects taken up at IIT Bombay. The Director stressed that a large number of faculty are working on technologies which have direct applications to homeland security and suggested that this can be harnessed by bringing them under one umbrella. In this connection he referred to Dr. Karandikar's interaction with Dr. Mahalingam of DRDO.

Prof. Khakhar proudly stated that IIT Bombay has a resource pool of about 500 experienced faculty members and hence there is a huge potential for very high end research and where the Centre could serve as an umbrella under which faculty members with different specializations could pursue research in relevant areas.

Dr. Sekhar (CC R&D, DRDO) explained the role of DRDO in homeland security in terms of sharing the DRDO resources and technology meant for armed forces with police and paramilitary forces. He stressed the role of educational institutes in research and development in the field of security.

Prof. Rangan Banerjee gave the outline of the day's proceedings, which had presentation by faculty and groups in five themes 1) Communication systems, 2) Imaging sensors, 3) Video surveillance and Image Processing 4) Robotics and Autonomous Devices and 5) Data Security and Cryptology. He mentioned that work at IITB is not limited to the mentioned themes and faculty member present but has a much larger scope. He stressed that to increase the scope and bring more members directly into this activity, and to address R&D in this challenging multidisciplinary area, we should have a "Center of Excellence for Homeland Security". He mentioned that IITB had a similar meeting with the Central Reserve Police Force. He also spoke about some of the models for interacting with other agencies such as the ISRO- IITB Cell which work on joint funding mechanism.

2. Presentations

Presentations on the following research areas were made to give a flavour of research and development work being carried out on various aspects of security at IIT Bombay.

- 'Communications Systems' - Prof. Karandikar, Dept. of Electrical Engineering (Annexure-3)

- 'RF Components and Systems' – Prof. Girish Kumar, Dept. of Electrical Engineering (Annexure-4)
- 'Sensors and Imaging' - Prof. Subhananda Chakrabarti, Dept. of Electrical Engineering (Annexure-5)
- Presentation and Demo on 'Sensor for IEDs' - Ms. Sheetal and Mr. Nehul Gullaiya (Annexure-6)
- 'Studies on the use of Meta-materials for terahertz applications'- Prof. R.P.R.C. Aiyar, CRNTS (Annexure -7)
- 'Landmine detection using GPR'- Prof. G. Venkatachalam, Dept. of Civil Engineering (Annexure-8)
- 'Video surveillance and Image Processing' - Prof. Subhasis Chaudhuri, Dept. of Electrical Engineering
- 'Robotics and Autonomous Devices' - Prof. C. Amarnath, Dept. of Mechanical Engineering.(Annexure-9)
- 'Autonomous Mini Aerial Vehicle' – Prof. Hemendra Arya, Dept. of Aerospace Engineering.(Annexure-10)
- 'Cryptology R &D' – Prof. V.R. Sule, Dept. of Electrical Engineering. (Annexure-11)
- 'Data Security and Cryptology' - Prof. P. Venkatachalam, CSRE.(Annexure-12)

3. Communication Systems (Annexure 3)

Prof. Karandikar made a consolidated presentation on Communication Systems RF Comb Generator for Jamming IEDs, RFIC Design, RFSystem Development.

He mentioned that the 26th November 2008 attack on Mumbai was basically the motivation to develop emergency communication system to force one Commando.

The developed system consists of a base station unit; commando unit with inbuilt camera & voice system; and a control centre server. The camera is mounted of the left side of the specs of the commando to give the best view.

Prof. Karandikar added that the complete unit of this model was designed and fabricated at IITB and the Industrial Design Centre in the institute had helped in the product design of each component.

In this connection, he also presented Prof. Shalabh Gupta's presentation on Signaling techniques to generate RF comb frequencies to jam IED (improvised explosive device) and Prof. Jayanta Mukkherjee's presentation on RFIC Design, RF System Development. He mentioned that a complete system has been developed in lab, with 3 different Prototypes namely, Direction Finder System, Chipless RFID Reader and Prototype Chipless RFID Tag.

DRDO scientist comments: Submit next phase of the project for immediate consideration

4. RF Components and Systems (Annexure-4)

Prof. Girish Kumar made presentation on RF Components & Systems.

He said that their work is comprehensive and they deal with both front end and back end.

He briefed that his team has developed a wide range of amplifiers, antennas and RF components required in wireless communications in the range of 800 to 8000 MHz. and 30 to 3000 MHz. and a variety of power devices such as mobile phones, attenuators, couplers and jammers of low, medium & high power ranging from 525 Watt.

He mentioned that he is working on the hardware part of GSM, GPS and GPS tracking system with memory and GPR which can detect up to 30cm down below.

Prof. Griish Kumar said that currently his team is working high power microwave system which can be used for ultra wave weapon bomb and other applications.

He spoke about his company 'Wilcom Technologies Pvt. Ltd.' which was incubated in the institute. The company deals with a variety of wireless products, which could be purchased.

DRDO scientist comments: DRDO have interest in Ground Penetration Radar (GPR), 6 feet or more. Generation of data base for identification of objects.

5. Sensors and Imaging (Annexure-5)

Prof. Subananda Chakraborti briefed about his project with ISRO on design, development, test and delivery of indigenous infrared focal plane arrays (IRFPAS)

He told about his work in InAs/GaSb-based Type II Strained Layer Superlattice (SLS) Detectors. The target is to develop high efficiency and high temperature operating focal plane array camera and are targeting on 325 to 256 FPA with given dimension. The final vision is to ultimately develop midway infrared and long way infrared ranging between 3 to 5 and 8 to 12 (units)

He spoke about his project activities in short term to develop Un-cooled and Cooled Imaging system and mentioned about the final target for Indigenous Development of IR FPA.

DRDO scientist comments: Device having 1024x1024 size, un-cooled system with smaller size and light weight for unmanned aerial vehicles.

6. Presentation and Demo on Sensor for IED's (Annexure-6)

Dr. Sheetal Patil elaborated on the explosive detector prototype developed at IITB. She explained about cantilevers, its sensitivity, how it will work as detector and demonstrated few prototypes.

Dr K. Sekhar, expressed his interest to take these samples for field testing but Mr. Nehul Gullaiya mentioned that at present it is not ready for testing but within 6 months it would be ready for test.

DRDO scientist comments: Keen on having samples and send it for user trials. Development of sensors for chemical warfare.

7. Studies on the use of Meta-materials for terahertz applications (Annexure-7)

Prof. Aiyar gave his presentation on Use of Meta-materials for Terahertz application

He briefed about Terahertz technology and its applications. He explained why Terahertz technology is needed and how it is useful in

- Detection of chemical and biological materials, hazardous organic materials
- Detection of explosives, hidden objects
- Scanning of mail and packages
- Dental applications, Cancer diagnostics
- Detection of forgery and counterfeits
- THz lidar, microscopy, astronomy

DRDO scientist comments: Emerging technology

8. Landmine detection using GPR (Annexure-8)

Prof. G. Venkatachalam described landmine detection using GPR. He mentioned that he and Prof. E.P. Rao together work in this area.

His presentation focused on the factors affecting GPR response to landmines and Research needed specifically under typical Indian scenarios. He said that at present his team is working on areas like detection and ranging of buried solids and hollow pipes, determination of radius of pipes and dielectric constant of soil, soil profiling, Simulation of GPR response under different ground conditions and SVM classification.

DRDO scientist comments: Can be used for generating database. Collaborate with LRDE Bangalore and R&D Engineers Pune for more inputs.

9. Video surveillance and Image Processing

Prof. Subhasis Chaudhuri briefed on Video surveillance and Image Processing.

He said that he and his colleagues in the Departments of Electrical Engineering, Computer Science, and CSRE are working on various aspects of Image processing, video analysis, satellite Imaging and optical imaging. He showed a few videos to demonstrate the various aspects of Image processing.

He also spoke about surveillance specific to the shape of the object. He mentioned how this would be helpful to locate and track a particular person in places like mall, and railway station.

DRDO scientist comments: Through wall imaging using heartbeat detection. Enhancing images from CCTV for facial recognition.

10. Robotics and Autonomous Devices (Annexure-9)

Prof. Amarnath described the prototype machine which was specifically developed for the Army.

He said that this robot could pick up objects weighing up to 20 kg for a distance of 10 feet and the machine could go over a culvert and simultaneously pick up objects below the culvert. He said that the machine had four cameras, through which the operator could look from a base station and control. Prof. Amarnath added that the machine is remotely controlled and it is very easy to train the operator.

All the cameras are imported, but other components of the machine are developed indigenously using products off the shelf.

It was mentioned that the testing of this machine was even carried out at J&K and that it could climb slushy slopes and move through water as well.

11. Autonomous Mini Aerial Vehicle (Annexure-10)

Prof. H. Arya presented an “Autonomous mini-aerial vehicle” He discussed the features and typical usage scenarios. He mentioned that these vehicles are hand locked.

Dr. Sekhar asked about effect of humidity on these vehicles to which Prof. Arya said that humidity is not an issue as for as this machine is concerned but the limitation or the constraint is that it can’t be used in windy area.

Further during the discussion, Dr. Mahalingam highlighted the problems with these type of vehicles. He said that in Bangalore most of these vehicles are attacked by birds, to which Prof. Girish kumar proposed a solution. He said it is possible to get rid of birds by producing ultrasound voice.

Prof. Arya said that he is also working on multiple aircraft and SOM controls.

12. **Cryptology R &D (Annexure-11)**

Prof. V. R. Sule spoke on research work done in cryptology at IIT Bombay. He explained the current activities at Dept. of Electrical Engg.

He spoke in detail about the various avenues and opportunities in the proposed centre. They are listed below:

- Carry out cryptology R&D of relevance to DRDO and other Government labs.
- Provide academic expertise and develop human resource for cryptology scientific force.
- Establish formal mechanisms for collaboration with Governmental agencies.
- Networking of academic experts to provide inputs for cryptological policy.
- Develop team work between multidisciplinary expertises.
- Get support for work on grand challenge R&D.

DRDO scientist comments: Highly relevant to DRDO. Interact with CAIR. Emphasis on manpower development.

13. Data Security and Cryptology (Annexure-12)

Prof. P. Venkatachalam spoke on Research and Development of Geospatial Data Security.

She explained the latest advancements in sensor technology, satellite remote sensing and field data measurements and its key application. She stressed on the need for research in special data security and privacy. In her presentation, she also mentioned about Water marking, both Invisible and blind marking.

DRDO scientist comments: Submit project to DRDO for consideration.

14. The Way ahead (Concluding Discussion)

- It was strongly felt by DRDO scientist that IIT Bombay has expertise and strengths to work towards R&D in homeland security.
- Development of nanosensors is an important area of R&D
- Training of manpower should be considered along with the research and development
- Meeting with all the user groups (CRPF, state police, ITBP, etc) to find common interest
- IIT Bombay shall organise a meeting with DGs Maharastra, J&K, Andhra Pradesh, Chhattisgarh, etc to get more insight into the requirements and focussed work.
- Other DRDO projects will continue and new project can be submitted through proper channels for considerations.

DRDO and IITB will work towards setting up a larger umbrella like “center of excellence for Internal Security”, for more focused and output directly to the users.

Meeting ended at 1P.M.