IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Agriculture Robots: Automated control and assessment strategy using distributed heterogeneous multi-agent system**	
Project Number	**IMURA0871**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address?
*(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*

1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research Themes:

Highlight which of the Academy's Theme(s) this project will address?
(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1	*Advanced computational engineering, simulation and manufacture*
2	*Infrastructure Engineering*
3	*Clean Energy*
4	*Water*
5	*Nanotechnology*
6	*Biotechnology and Stem Cell Research*
7	*Humanities and social sciences*
8	Design

The research problem

Define the problem

Agriculture industry makes one of the dominant parts of the economy of any country and this is equally applicable to both Australia and India. This industry is facing a whirlwind due to global warming and abnormal weather patterns that has posed a threat to food security in various parts of the world.

Modern farming practices make use of advanced techniques and automated machinery for effectively increasing productivity and reducing waste throughout the food supply chain. Robotics and autonomous systems are set to transform many global industries and agricultural robots have found their way in the market. **The agricultural robots are** characterized by the application (such as harvesting and navigation) and by the types of functions that they perform (such as data collection, inspection and management). There are numerous commercial systems in global market for the former, including heavy automated machinery (non-robotic), however the inspection and livestock management application is estimated to grow at the highest rates in the coming years. This rapid growth rate creates challenges for manual and regular inspection of the crops through the growth process before becoming ready for harvest or collection from the agriculture fields.

One of the most crucial part is comprehensive soil and crop testing for nutrient deficiencies and fertiliser requirements at various phases. This requires routine scientific analysis of soil and additives for several vital parameters at various stages by agricultural scientists. Most of them are done on samples in labs as well as performed in real-time in the farms by multiple hand-held instruments. The latter requires highly skilled personnel to use specified tools and protocols and analyse the results from various instruments for easy feedback to the farmers to adopt specific actions accordingly. In our project, we would like to automate this subjective and time-consuming process by devising multi-agent, customized robots for collecting and analysing soil and crop status *in situ*.

Project aims

Define the aims of the project

In this project, we propose to investigate into small, light-weight, multi-agent agribots, equipped with novel sensors (sensors being developed at IIT Bombay) for inspection and monitoring of various conditions of the soil and plant with respect to the use of water and fertilizers.

The scope of this project would involve: 1) multi-agent integrated hardware and software systems used for replacing stationary sensors with fixed position, maintaining the sensor signal acquisition, preliminary processing onboard; 2) networking and sending this information over cloud to specific labs where the data would be further processed and analysed; 3) automated evaluation and AI based predictive analysis for a)the farmer for her/his tracking and b) the monitoring agencies for their quantitative records data-base, low-cost Internet of Things (IoT) technologies and advanced statistical analyses and further necessary action.

The developed technology would, therefore, also provide an efficient means to help in collecting the data on weather, temperature, moisture, humidity and other relevant parameters for optimising yield, improving the farming practices, make better decisions on the required resources and their distribution to minimise waste.

Expected outcomes

Highlight the expected outcomes of the project

1. Smart Inspection multi-agent system (procured std. configurations for flying and mobile agents) for the field parameter sampling, sensor signal recording, monitoring and data base generation;
2. Processing and data analysis approaches;
3. IoT techniques for data communication.

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

- It will involve novel multi-agent integrated system;
- Computing, numerical simulation and signal/data-processing and analysis techniques;
- IoT and data communication with automated feedback mechanism to the farmer and agricultural scientists

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

- ECE/Mechatronics engineering background candidate with both HW and SW skills, automated system navigation and control, AI and networking skills.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Dr. Rajul Patkar

We will also interact with one or two agriculture scientists from ICAR or other agriculture institutes.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

1. Robotics, Mechatronics, UAVs (30)
2. Sensor and Sensor Networks (13)
3. Signal Processing (14)
4. Networks and Telecommunications (26)
5. Systems Analysis and Control (29)