

Indo/US Collaborative Research Grants

National Science Foundation of US and Technology Innovation Hubs of India



Title: Enabling Energy and Safety-Awareness in Autonomous Robotics for Smart Agriculture

Indian PI: Prof. Anirban Guha, Department of Mechanical Engineering, IIT Bombay, India.

Indian Co-PI: Prof. Arpita Sinha, Systems and Control Engineering, IIT Bombay, India.

US PIs: Prof. Satadru Dey, Department of Mechanical Engineering, Pennsylvania State University, USA.

Smart agriculture can play a key role in addressing the challenge of global food security. In the context of Indian agriculture, the fundamental challenges in farm robotics arise from adverse environmental and operating conditions. Accordingly, a robotics solution should consider the presence of unsafe environments and efficient utilization of energy. A battery-powered autonomous robot-based Internet of Things (IoT) platform can be an answer to this. Its desired properties are situational awareness, low human intervention, low energy consumption and high battery safety. This proposal seeks to answer the following question: **How do we enable energy and safety-awareness in a battery-powered autonomous robotic IoT platform for agricultural applications? To address this question, this project brings together a co-design framework combining three disciplines: mechanism design (led by Anirban Guha - India), path planning (led by Arpita Sinha - India) and battery management (led by Satadru Dey - USA). This is a unique effort in the field of agricultural robotics.** The deliverables are a mechanism (designed and fabricated), a path planning algorithm, a battery management algorithm and a hardware-in-the-loop testbed. We will demonstrate the ability to complete harvesting without any manual intervention, path following and power demand satisfaction. The device will be able to detect the need to recharge, predict the power needed to return to the recharging station and choose the appropriate return path. For demonstration, this project focuses on a small onion harvester suitable for small and fragmented farms of India but the technology developed can be used for larger devices and for other agricultural applications too.

