Our proposed research is motivated by two fundamental challenges studied in two separate disciplines. (a) The premise of our proposal is that the aforementioned challenges can be more effectively addressed if we solve them together than tackle them separately. (b) The lack of versatile camera systems in a small form factor. Our proposed solution is to develop a ‘smart’ flexible sheet with an integrated micro-camera array, wherein the cameras can individually or collectively target and track objects at different angles and distances.

**MOTIVATION**

- **Challenge in image sensing:** Lack of versatile camera systems in a small form factor.
- **Challenge in image understanding:** Lack of algorithms that can recognize a generic 3D scene/object from 2D photos.

**RESEARCH PLAN**

The premise of our proposal is that the aforementioned challenges can be more effectively addressed if we solve them together than tackle them separately.

**Hardware Implementation Strategy**

- Fabrication of variable-focus lenses for the micro-cameras.
- Develop light concentrators for enhanced collection and concentration of light to compensate for small lens apertures.
- Design efficient micro-scale actuators for on-demand direction control of the cameras.
- Realize the flexible camera sheet using batch fabrication techniques.

**Software Implementation Strategy**

- Develop efficient algorithms to combine noisy image data from multiple cameras into a single sharp image.
- Design new software to integrate the processes of depth estimation and object/scene recognition.
- Use human-user interaction to train the new model for generic object/scene recognition with minimum supervision.

**CURRENT PROGRESS**

**Tunable Lenses**

![Schematic of proposed device structure](image)

**Image processing**

- Developed multi-view image noise reduction algorithm for camera array using a data structure called 3D focal image stacks.

**Light Concentrators**

- Developed and fabricated an artificial light collector array to improve the imaging ability of sensors in dim environments.

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