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Computational Scheimpflug Imaging for Improving
the Depth of Field of Iris Recognition Systems

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Iris recognition is a promising biometric surveillance technology. However, the inability of an iris camera to operate across a large range severely restricts its use. For example, subjects are required to either stand still at a fixed standoff distance or move slowly through a pre-defined and narrow zone during the capture. Such restrictions pose sever challenges for scaling iris recognition systems that can be used with multiple subjects and in crowded areas.

Two main methods for improving the imaging volume of current iris cameras have been proposed recently: By making the imaging system's response insensitive to focusing errors using wavefront coding. Or by aggregating a large imaging volume using multiple cameras juxtaposed in time or space. While the wavefront coding systems improve the imaging volume by a few folds at close standoff distances, they generally entail high computational cost and are plagued by low SNR. The second method, which requires multiple synchronized cameras for tracking and capturing subjects with the specified volume, has significant system complexity and incur high system cost.

To extend the imaging volume of iris acquisition systems by multiple folds while using a single camera, I propose to use a combination of classical scheimpflug photography with modern computational imaging. Using scheimpflug imaging techniques, the plane of sharp focus and the associated DOF can be oriented within a prescribed imaging volume. An optimal orientation of the DOF will be found that maximizes the ability to capture in-focus iris images from multiple subjects positioned within the volume. Computational imaging techniques will be used to address the space variance associated with scheimpflug imaging, and for further improving the spatial resolution of the camera.

The complexity of such a system is minimal as it will not require multiple cameras and sophisticated tracking mechanism. This system can be scaled simply by using a lens with higher magnification and/ or a sensor with larger area which can be highly cost effective and efficient for installment in public places.

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DEDICATION

Dedicated to my wife, parents, parents-in-law, brother, sister, and friends.