Objectives/Rationale: Over one million US Veterans have visual impairments that affect their ability to perform activities of daily living necessary for self-care and independence. In this proposal, we describe a new wearable computing device called HandSight aimed at supporting these activities by allowing blind and low-vision persons to glean visual information about objects simply by touching them. HandSight consists of a set of tiny cameras and physical feedback components (e.g., a vibration motor such as in a mobile phone) mounted on one or more fingers. The device will sense visual attributes about the physical world and feed back this information as it is touched through speech output and physical vibration or pressure on the finger. For example, imagine touching a printed page and hearing it read aloud while vibration cues guide your fingers along the text or picking up a bell pepper and instantly recognizing that it is red or green, or even touching a shirt in your closet and having it described along with recommendations for what to wear with it.

Our objectives are twofold. The first objective is to develop the basic components of HandSight required to support a range of everyday needs. This phase of the work includes software questions, such as developing algorithms tailored to finger-mounted cameras to interpret text and recognize different surfaces. It also includes physical design and feedback questions, such as how many cameras to use, how to mount the device to the finger comfortably, and how to provide vibrational feedback that can be easily understood by the user. Once these basic components have been developed, the second objective is to explore and demonstrate the potential of HandSight through building and evaluating three preliminary applications: reading printed text, dressing and clothes coordination, and mobile technology access.

Applicability/Potential Impact: Our goal is to build a fundamentally new way of interacting with the physical world that should enable Veterans with visual impairments to perform activities of daily living independently and with increased confidence. These benefits, in turn, should impact overall quality of life and sense of social inclusion. While we believe there are significant benefits of HandSight for totally blind individuals, our goal is to also demonstrate value to the larger visually impaired population. The Department of Veterans Affairs estimates that 157,000 US Veterans are legally blind, and more than one million have low vision that causes loss of ability to perform activities of daily living. Unobtrusively reading text by lightly touching it with the fingers, for example, holds significant promise for both populations.

Military Benefit: Eye trauma is one of the most prevalent areas of combat injury from the Iraq and Afghanistan wars. Moreover, the overall number of Veterans with visual impairments is expected to rise dramatically as Veterans from the Korean and Vietnam conflict eras develop vision loss from age-related diseases such as macular degeneration, diabetic retinopathy and glaucoma. This aging population trend is not exclusive to Veterans but also affects their families (e.g., spouses, siblings) and the civilian population as a whole. Indeed, the
National Federation of the Blind reports that the visually impaired population will double in the next 30 years due to age-related diseases. Additionally, our algorithms, design guidelines, and findings should apply broadly to future finger-based computer vision systems. While our focus is on people with visual impairments, our approach could also be extended to enable applications for scenarios with poor or no visibility for sighted people. The HandSight platform could thus have much broader military application that could be explored in follow-up work.