Development of a Medically Specific Night Vision Device for Use in Military Operations

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Introduction

Night vision devices (NVDs) are essential to American military tactical advantage, but their usefulness can extend beyond the battlefield, allowing medical providers to conduct procedures in low-light environments. Unfortunately, standard NVDs remain limited by optical constraints. Recognizing the nature of large-scale combat operations (LSCO), where casualty evacuation will be hampered by limited air superiority, the ability to conduct surgical operations within far-forward, austere conditions will be lifesaving.

Objectives

Develop and refine NVDs that are:

- Optimized for the safe performance of medical procedures and surgical operations
- Suitable for no or low-light conditions
- Reliable and durable within austere environments
- Easily portable
- Capable of providing peer-to-peer connectivity

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Initial Studies and Prototype Timeline

- 2018-2020: Surgeons at Madigan Army Medical Center used standard NVDs to perform resuscitative surgery on a porcine polytrauma model.
  - Life-saving interventions were successfully executed, but optics limited certain procedures.
- 2020: *Minimal funding secured by Madigan to develop a prototype device featuring:
  - Dynamic magnification and autofocus capabilities
  - Liquid lenses to minimize moving parts
- 2023-2026: **Funding secured by our collaborator, Yang Liu, PhD (Univ of Iowa), to further develop the prototype:
  - Stereoscopic imaging and user personalization
  - Near-infrared LEDs with a fine-tuned handheld controller
  - Low-light visualization capabilities

Figure 1. Surgical procedure being performed on cadaveric models with standard NVDs (left) and prototype NVDs (right), highlighting difference in resolution and clarity.

Upgraded Surgical Night Vision Device

The Current Prototype Features:

- Improved display resolution and faster autofocus
- Fully self-contained capability without need for an external laptop
- Reduced weight and smaller size for improved portability

Looking Ahead

- Performance of trauma surgery procedures by U.S. Army surgeons on both cadaveric and live tissue porcine models to assess device efficacy and usability compared to standard NVDs and previous prototypes.
- Outfit third prototype with peer-to-peer connectivity.
- Implementation of these medically-specific NVDs in both the military and civilian sector.

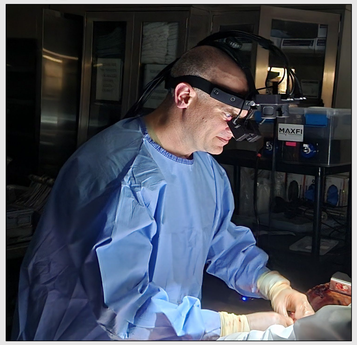

Figure 2. NVD Prototype testing on cadaveric models

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