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RESEARCH & DEVELOPMENT ®

Methods to Assess Remote Photoplethysmography Based Vital Sign Monitoring in a Clinical Environment

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Introduction

The Patient Handling via Audio, Recording and Observation System (PHAROS) prototype was developed by Areté Associates through the Small Business Innovation Research (SBIR) program. PHAROS uses remote photoplethysmography[1-6] and other computer-vision methods to non-invasively estimate vital signs.

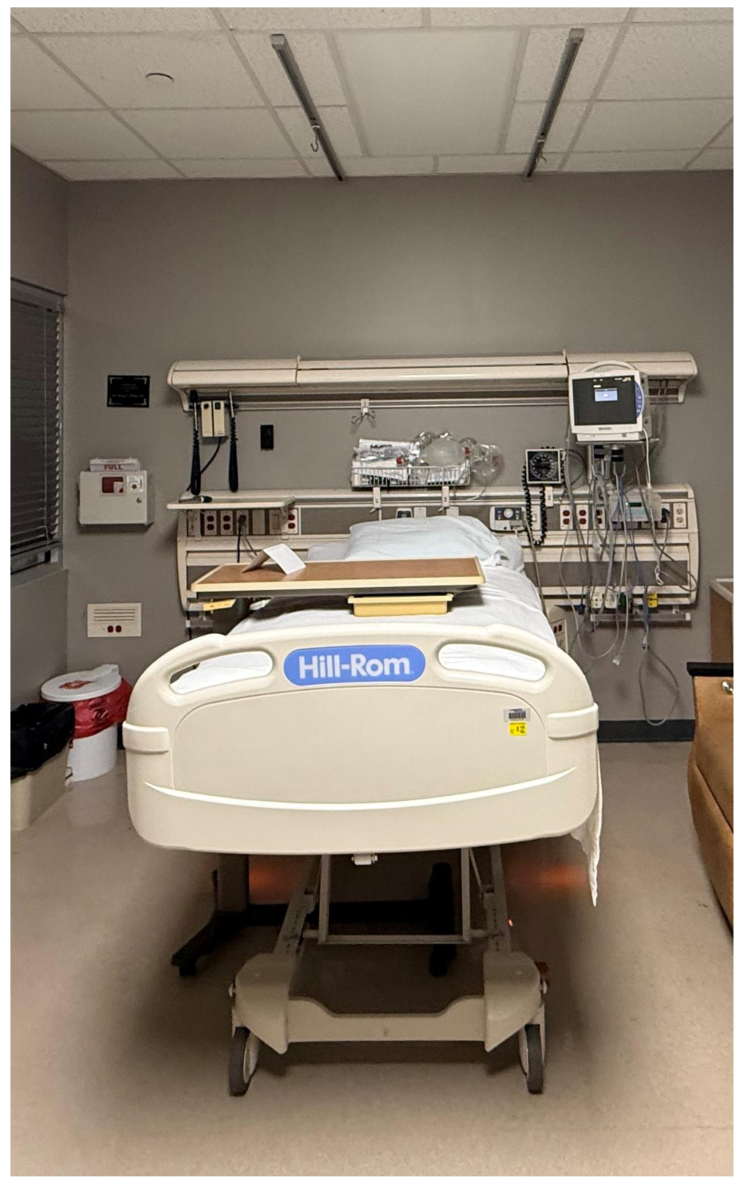
The major hardware components of the PHAROS system include an Artificial Intelligence (AI) Processor and up to multiple High Dynamic Range (HDR) Video Cameras:

NVIDIA AI Processor

HDR Video Cameras

To advance accuracy, reliability, and operational robustness of the system, a partnership between the USAISR and the Medical College of Georgia has been established. This effort will leverage real-world patient encounters at Dodge County Hospital in Eastman, Georgia.

Clinical Environment



The AI processor unit will be placed in a locked cabinet in the designated clinical spaces.

Two HDR cameras will be mounted within a customized housing above the patient's bed.

Both the custom processor cabinets and the HDR camera mountings were designed and produced by the Garage Makerspace facility at Augusta University.

Methods

The Medical College of Georgia received a research determination in March 2026. As a result, the PHAROS system will be deployed for 3 months starting in late summer of 2026. PHAROS-derived vital signs will be compared with simultaneous ground-truth measurements from clinical bedside monitors.

Each recording period will be Annotated to capture variables influencing the software performance, including patient characteristics, clinical presentation, environmental conditions, medical equipment or objects within the camera's region of interest (ROI), ongoing procedures, presence of non-patients in the ROI, and monitoring duration.

Bedside Clinical Monitor

To annotate patient skin tones, the research team has determined that the widely used six-point Fitzpatrick Skin Type[7] tool does not offer the desired specificity of the Monk Skin Tone (MST)[8] scale. The MST scale has recently gained tracking in dermatology computer vision work due to the finer granularity it offers as the darker end of the spectrum and is more applicable to this clinical assessment project[9].

Monk Skin Tone Scale

1	2	3	4	5	6	7	8	9	10

The annotations will enable margin of error (MOE) calculations across diverse clinical conditions. Seventy-five percent of the annotated dataset will be used to train the updated software models, while the remaining 25% will serve as a validation set for future software assessments.

Discussion

Patient privacy and data security are essential for this project. Safeguards include disconnected/offline system operations, secure housings, encrypted data storage, disabled audio capture, and use of the Secure Anonymization and Encryption Framework[10] tools to remove or mask identifying information. These protections ensure ethical and compliant data handling while enabling collection of high-quality clinical data.

Hypothesis

The PHAROS system will accurately monitor vital signs using passive, computer vision technologies over time when evaluated against ground truth data measurements of clinical patients in the emergency department or intensive care unit of a rural hospital. Specifically, heart rate and respiration rates calculated by the PHAROS AI tools will be accurate within a 5% MOE when compared to simultaneously recorded vital sign readings (e.g., ground truth data sets) of patients in a clinical environment.

Additionally, the robustness of the PHAROS system to collect passive vital sign monitoring (VSM) will be evaluated in several milieu including:

- Patient Characteristics
- Patient Clinical Presentation
- Duration of the VSM Observation Time Period
- Environmental Conditions
- Presence of Medical Objects in the ROI
- Performance of Medical Procedures in the ROI

Results to Date

Prior human-subject testing has been limited to healthy individuals. In those evaluations, PHAROS achieved accuracy within ±5 beats per minute for heart rate and ±3 breaths per minute for respiratory rate.

This clinical deployment is the inaugural real-world evaluation of the system, gathering vital metrics on performance relative to patient acuity, motion, ambient lighting, and procedural differences. As the most rigorous field test of the PHAROS system to date, the resulting data will directly inform system optimization and expedite subsequent development phases.

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