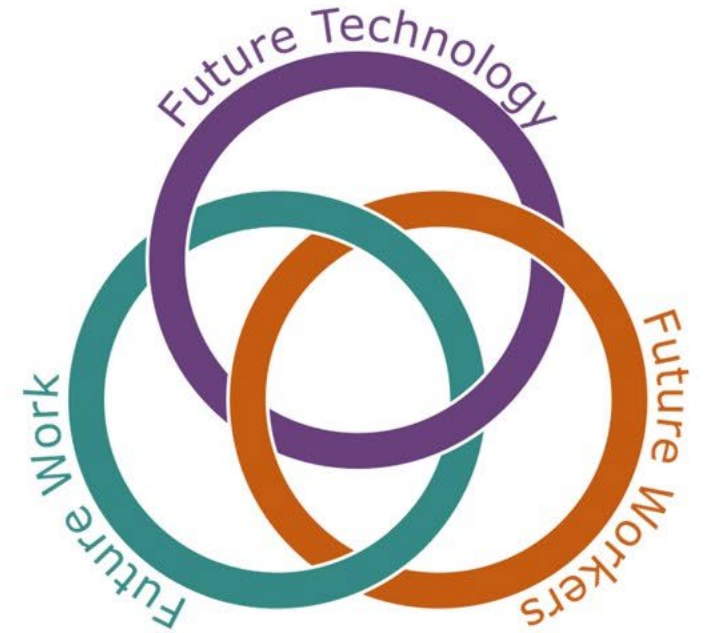
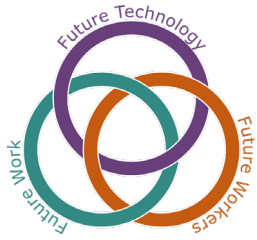


Panel 3:

Health, Healthcare; Point of Care

- Clinical Skill Acquisition, Retention and Atrophy with Artificial Intelligence Aids
- Future Matrix of Care: Communities, Networks, and Technologies
- Human-Machine Teaming for Medical Decision Making
- Measuring learning gains in man-machine assemblage when augmenting radiology work with artificial intelligence
- Physiological Sensing to Enable Expert Decision-Making in Healthcare
- Robotic Health Assistants: A New Human-Machine Partnership in Home Healthcare
- The future expert work in the age of "black box", data-intensive, and algorithmically augmented healthcare





DUE-1928485: FW-HTF-P: Clinical Skill Acquisition, Retention and Atrophy with Artificial Intelligence Aids

Soumya Ray (sray), M. Cenk Cavusoglu (mcc14), Brooke Macnamara (bnm24)
Case Western Reserve University (case.edu)

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As artificial intelligence applications (AI) increase, it is increasingly likely that many future workers will collaborate with an *AI assistant* (AIA). This project seeks to understand whether, and how, *human* skill acquisition, retention and atrophy is affected by AIAs, and how this aspect can influence AIA design.

Future Technology Question: How can AIAs be designed to improve human skill acquisition and retention?

Current and Future Directions:

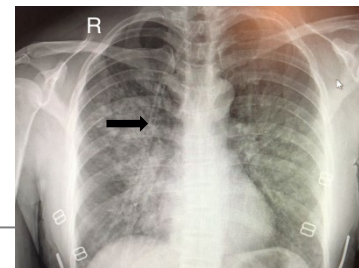
- Evaluate different AIA modalities to provide feedback during task performance
- Evaluate impact of AIA accuracy
- Evaluate AIA UI design



Future Work Question: How do AIAs enable new work areas and change current ones?

Current and Future Directions:

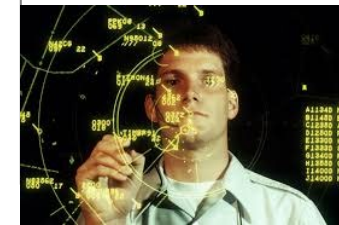
- Explore new work areas enabled by AIAs, such as surgical robotics
- Explore how existing work, such as visual search in radiology, are affected by the presence of AIAs
- Generalize learned principles to other areas

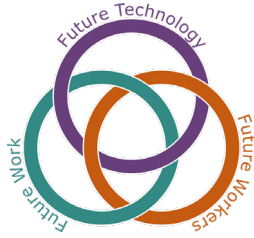


Future Workers Question: How do workers acquire and apply skills when an AIA is present?

Current and Future Directions:

- Design experiments to study how human skills are affected when humans interact with AIAs
- Discover the conditions under which human skills atrophy and skill learning is hindered





Future expert work in the age of "black box", data-intensive, and algorithmically augmented healthcare

Awards #1928614, 1928586

PIs: O. Nov, Y. Aphinyanaphongs, D. Mann, Y. Lui, M. Porfiri, J. Rizzo, B. Wiesenfeld, M. Riedl



Working closely with healthcare professionals, we (1) study the interactions between experts, clients and cognition-augmenting technologies, and (2) develop new technologies and workflows to make work responsive and empowering.

Future Technology

New data-intensive and AI-based tools in multiple medical domains:

- Develop a tool to predict medication order errors based on providers' data
- Develop a tool to predict short-term adverse events in COVID patients
- Develop a dashboard of mobility patterns of low-vision patients
- Develop, implement and study short-term mortality prediction tool
- Elicit algorithmic advice design tradeoffs for multiple stakeholders
- Develop, validate and test tool for automating and quantifying tumor growth

Future Work

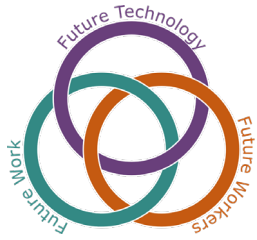
...taking into account professionals' current and envisioned workflows

- Control medication order error tradeoffs in doctors' and clinical pharmacists' workflows
- Ensure effective care to COVID patients and make room for new patients
- Transform orientation & mobility training of low vision patients
- Study how medical teams use mortality prediction in caring for very sick people
- Understand the tradeoff between optimal vs. widely accepted algorithmic advice design
- Study the integration of medical imaging AI tools to clinical environment

Future Workers

...making work rewarding and empowering

- Reduce pharmacists' workload and stress by focusing on error-prone medication orders
- Reduce providers' uncertainty about discharge implications
- Make instructors' work more focused and evidence-based
- Align providers' representation of patient's condition, potential decisions, relevant data
- Bring designers and providers of algorithmic advice closer to their users
- Understand end users' perspectives on deployment and its challenges



Human Machine-Teaming for Medical Decision Making (#1840088)

PI(s): Suchi Saria and Chien-Ming Huang, Johns Hopkins University,
ssaria@cs.jhu.edu cmhuang@cs.jhu.edu

Goal: Study barriers to engagement and adoption when implementing expert-in-the loop systems in high-stakes environments by examining real-time interactions between providers and a deployed machine learning-based clinical decision support system

Discovered attributes that clinical decision support systems need in order to establish trust with expert users and facilitate human and machine collaboration in a high-stakes settings

Future work: Incorporate these insights into the design of new expert-in-the-loop systems

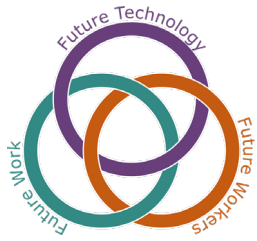
Identified patterns of behavior associated with delayed patient care and worse outcomes

E.g., need to raise awareness about patients with less common symptom presentations. so that clinicians trust the alerts on these patients and reduce treatment delays

Identified environmental factors that are associated with decreased adoption of alerts

E.g., alerts occurring around the morning shift change are associated with increased delays in response, suggesting the need for supplemental alert monitors during this time to support clinicians

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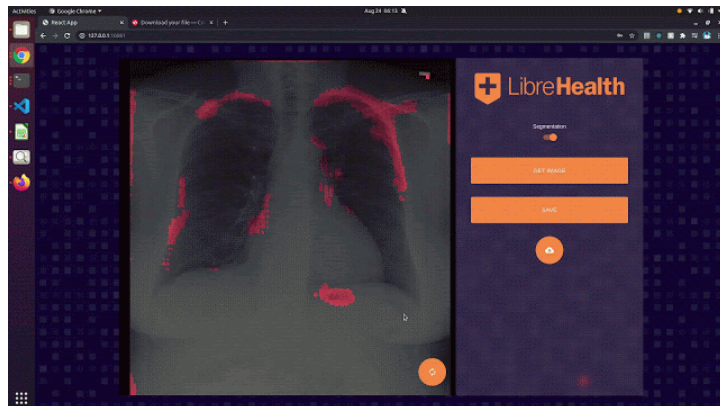


#1928481 - FW-HTF-RM: Measuring learning gains in man-machine assemblage when augmenting radiology work with artificial intelligence.

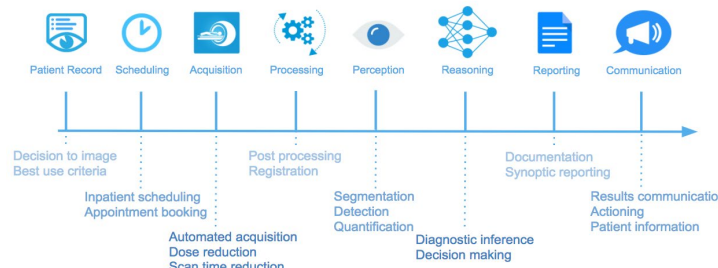
PI(s): Saptarshi Purkayastha, Indiana University - Purdue University Indianapolis, saptpurk@iupui.edu
 Judy Gichoya, Emory University, judywawira@emory.edu
 Joshua Danish, Indiana University, jdaniel@indiana.edu
 Elizabeth Krupinski, Emory University, elizabeth.anne.krupinski@emory.edu

A conundrum at the human-technology frontier remains - will humans be augmented by technology or will technology be augmented by humans? We develop a new learning paradigm called *assemblage learning* that removes the conundrum, which we are testing in the work setting of radiology. We build and test AI tools in the radiology workflow to fit with the capabilities of human radiologists and improve the Radiologist-AI synergistic partnership.

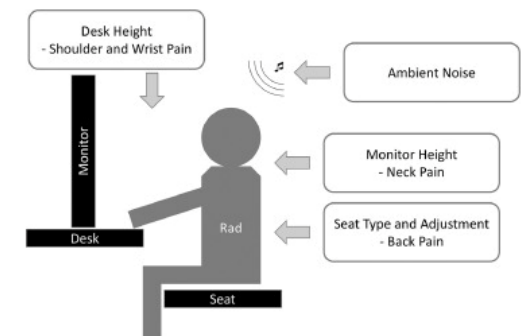
- Identified state-of-the-art algorithms and tools that have been implemented or are in the process of implementation and identify the challenges and opportunities to improve these for assemblage learning.
- We integrated AI models into the LibreHealth Radiology Information System's (RIS) DICOM Image viewer.



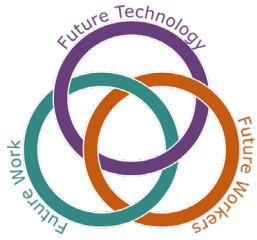
- We performed a user-study with resident radiologists at IU about the needs for human-AI collaboration and requirements for assistance from AI models at different parts of the workflow.
- We performed feasibility testing of using one-shot learning to retrain the AI models with the changes that are made to the model based on annotations by radiologists. This is then combined with multiple assemblages - *swarm learning*.



- We identified serious embedded failures in AI models in radiology that may be rectified through human collaboration and one-shot learning. Thus, new training tasks (POGIL) and AI-knowledge needs to be created.
- Ambient lighting, brightness of monitors, ergonomic workstation and software etc. reduce fatigue, but also partnerships with multiple readers reduces fatigue.



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FW-HTF-P: Physiological sensing to enable expert decision-making in healthcare (Grant #: IIS-1928661)

PI: Denny Yu, PhD, School of Industrial Engineering, Purdue University

CoPI: Tera Hornbeck, DNP, RN, AGCNS-BC, School of Nursing, Purdue University

CoPI: Md Munirul Haque, PhD, University of Indianapolis

contact: dennyyu@purdue.edu

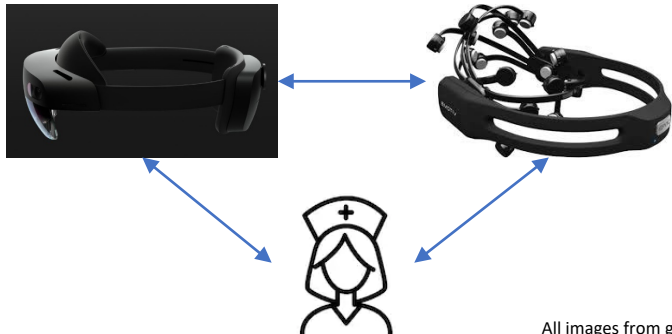


In healthcare, failure to rescue and recognize deteriorating patients can directly impact their outcomes. Nurses are on the front lines of patient care, and their ability to synthesize information rapidly and make appropriate decisions about deteriorating patients is critical. **The goals of this project are to:**

1. Explore expert nurse decision-making (DM) and situation awareness (SA) and develop technology to enhance novice nurse DM/SA
2. Utilize simulation-based scenarios to assess differences in expert and novice nurse DM/SA
3. Study effectiveness of technology to enhance novice nurse DM/SA

Future Technology

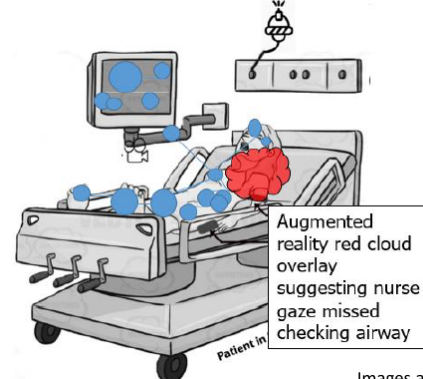
- Augmented reality (AR) with human-in-the-loop sensing can provide realtime guidance to enhance DM and SA



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Future Work

- Experts quickly grasp complex clinical situations, rapidly and confidently come to an accurate assessment and provide safe quality care to patients



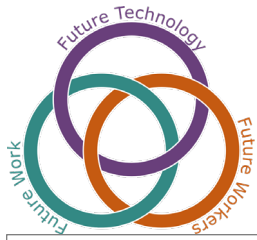
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Future Workers

- Nursing face shortages due to a lack of potential educators, turnover (burnout), aging workforce, aging population, and inequitable workforce distribution



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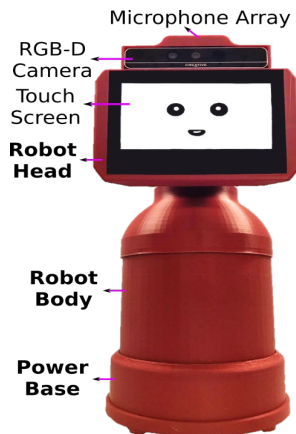
NSF FW-HTF DUE 1928711: Robotic Health Assistants: A New Human-Machine Partnership in Home Healthcare

PI(s): Weihua Sheng, Alex Bishop, Oklahoma State University
Barbara Carlson, University of Oklahoma Health Science Center
Email: weihua.sheng@okstate.edu, Phone: 405-7447590

The **long-term goal** of this project is to **empower home healthcare providers to achieve high productivity and quality of work life** by developing a robotic health assistant (RoHA)-based smart home healthcare system (SHHS). The **objectives** of this planning project are two-folds: 1) building the research team and fostering collaboration with industry partners and stakeholders to develop the research concept of a Robotic Health Assistant (RoHA)-based Smart Home Healthcare System (SHHS); 2) conducting preliminary study and test of this new concept.

This project develops innovative robotics and artificial intelligence (AI) technologies to augment the productivity and quality of work life of home healthcare workers.

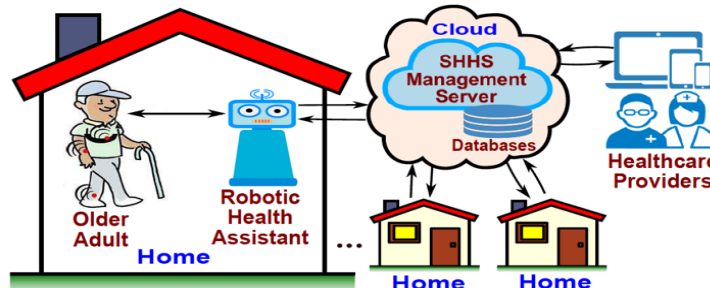
Fundamental research problems include:
Human Machine Interface; Robot Learning; Privacy Protection.



This project will deepen our understanding of the impact of AI on caregivers and uncover ways to help them adapt to this new work model.

RoHA-base SHHS will assist healthcare professionals through the following core functions:

Health Monitoring; Healthcare Delivery and Healthcare Literacy.



This project will nurture a new generation of caregivers (particularly CNAs) who will embrace the inevitable transformation of the home healthcare industry.

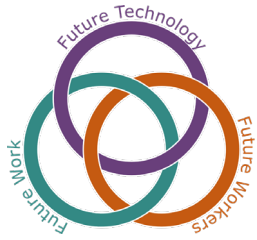
A virtual workshop was conducted on Nov. 20th, 2020 to educate the local healthcare community about the RoHA and its potential use in home healthcare. Over 40 healthcare professionals attended the workshop. For details please visit

<https://rhassistants.wixsite.com/nsfworkshop>



Robotic Health Assistants: A New Human-Machine Partnership in Home Healthcare





SES-1928547 “The Future Matrix of Care: Communities, Networks, and Technologies

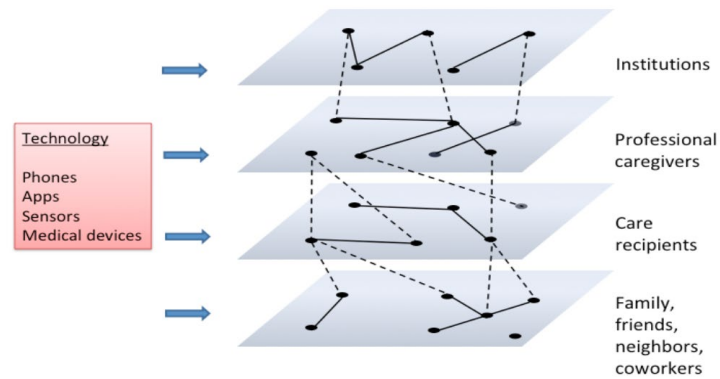
PI: Selma Šabanović, Indiana Univ. Bloomington, selmas@Indiana.edu;
Hamid Ekbia, Nathan Ensmenger, Josette Jones, Staša Milojević

This planning grant develops aims to study care work within a “**matrix of care**” – a polycentric network of institutions, formal and informal caregivers, care receivers, community members, and intelligent technologies. Activities include case studies of care work, along with interviews and co-design with workers, involved in dementia care.

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The Future of Dementia Care Work

- Institutional partners: Jill’s House, Dementia Action Alliance, etc.
- Interviews with dementia care workers, observation in workplaces
- *Care work crossing community, institutional, and home contexts and different sociotechnical ecosystems*



Future Dementia Care Workers

- Workshops on care practices and use of technology in home dementia care
- “Invisible work” needed to adapt and maintain technology during care
- *New roles and skills needed to work with technology (e.g. managing care receiver interaction with technology, identifying appropriate uses of tech)*



Future Technology for Dementia Care

- Codesign of future dementia care support technologies with care givers
- Current focus is on adaptation of individual technologies
- *Need for more integrated platforms that connect diverse technologies and stakeholders and can be adapted to various contexts.*

