Project Title

PreSAGE: A Smart Bed-Exit Prediction and Prevention System based on Thermal Sensing

Project Lead and Members

Project lead: Tan Tzuu Ling- Clinical PI, Shen Nansheng-Technical PI

Project members: Julien Tan Cheun Woei, Dr Yoke Wong Kin Yoke, Dr Hoi Shu Yin, Tan Swee Yen

Organisation(s) Involved

Tan Tock Seng Hospital

Project Period

Start date: Apr-2016

Completed date: Mar-2017

Aims

To study the feasibility of an automated fall detection and surveillance system using thermal imaging that allows smart video analytics whilst preserving privacy for high fall risk patients.

Background

Falls injuries often results in hip fractures, head injuries, requires medical attention, increases hospital costs and length of stay, and adds burden to the manpower-starved healthcare industry. A cost analysis performed in TTSH showed that every inpatient fall with major injury cost $32,189. It is calculated that 65% of the inpatient falls in TTSH occurred at bedside and 50% occurred without the presence of a witness. This lack of accurate information on how falls occurred, lead to missed learning opportunities to prevent falls and to address them through optimizing workflow and environment design. Current findings showed no conclusive effectiveness from hip protectors, movement alarms or low-beds that were originally thought to reduce falls or injuries

in hospital settings. Effective fall prevention strategies leveraging on technology can reduce bedside falls and the burden on resource utilization.

Methods

The study was conducted in single-bedded, air-conditioned rooms. Baseline study includes understanding various bed-exit scenarios and the ability to differentiate or identify objects. The thermal imaging unit was deployed in a general ward for 13 months. 80 patients were recruited for this study. A preliminary model was built using image recording to train the system on human and generic object identification such as bed, chair in the patient room. A secondary model was thereafter trained to identify different patient positions and movements in various bed-exit scenarios. An artificial intelligence system was then built to recognize such movements and predict bed-exit. The system was integrated with alarms and front-end graphic interface for system validation. A three-phased observational study was then conducted.

Results

The sensitivity reported was 99.7%. The one episode where system did not detect the bed-exit occurred when the second person was leaving the surveillance area before the system was armed backed on, thereby did not trigger an alarm when the patient exited bed without assistance. The specificity was 100%.

Lessons Learnt

 Stakeholder identification and engagement is paramount to implementation success. An agreed timeline and Gantt chart is a helpful visual collaborative tool to stay on track and meet project goals. With respect to IT/digital projects, it would be beneficial to have a IT project manager before commencing the project to assist and navigate with IT requirements.

Conclusion

The proof-of-concept study has produced metrics and evidence that conforms to clinical standards. Through the experience of this prototype, many insights were

gained from nurses, clinicians and users. The human-centric approach to designing this solution provided further insights on the opportunities and constraints to iterate on an improved PreSAGE system that is aspirational to both patients and clinicians needs.

Additional Information

Asia Pacific HIMSS-Elsevier Digital Healthcare Award 2019 – Winner of Outstanding ICT Innovation Award

Project Category

Care Redesign, Automation, IT & Robotics

Keywords

Care Redesign, Automation, IT & Robotics, Machine Learning, Artificial Intelligence, Fall Prevention, Fall Detection, Nursing, Tan Tock Seng Hospital, CoNEX Healthcare Pte Ltd, PreSAGE, Smart Bed, Predictive Bed-Exit, Thermal Sensing

Name and Email of Project Contact Person(s)

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PreSAGE
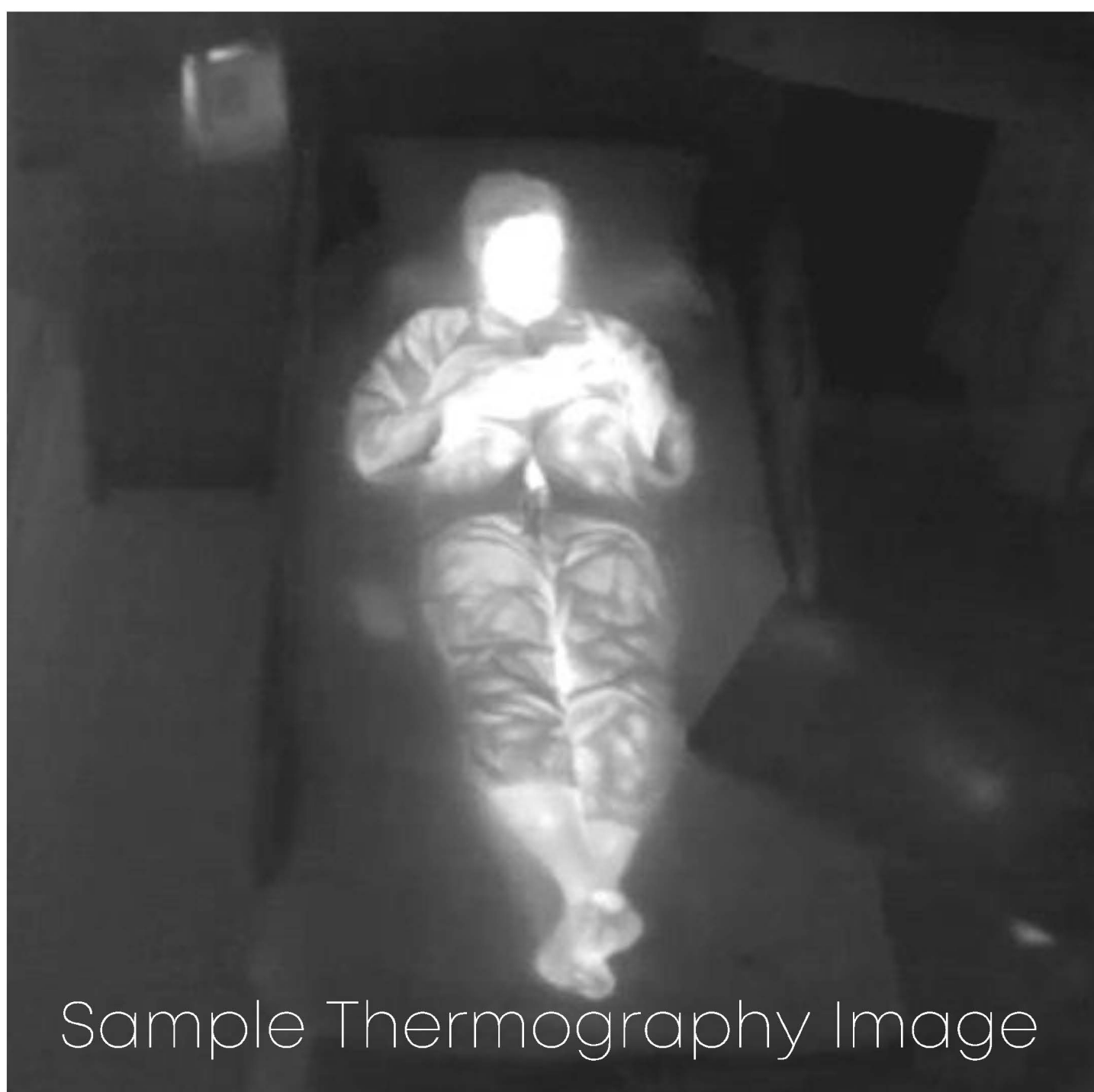Better Prediction Better Care

Tan Tock Seng
HOSPITAL

PreSAGE – Mitigating Fall Risks with Machine Learning and Artificial Intelligence

PreSAGE is a predictive patient monitoring platform that emphasizes on three key design principles:
- Non-contact
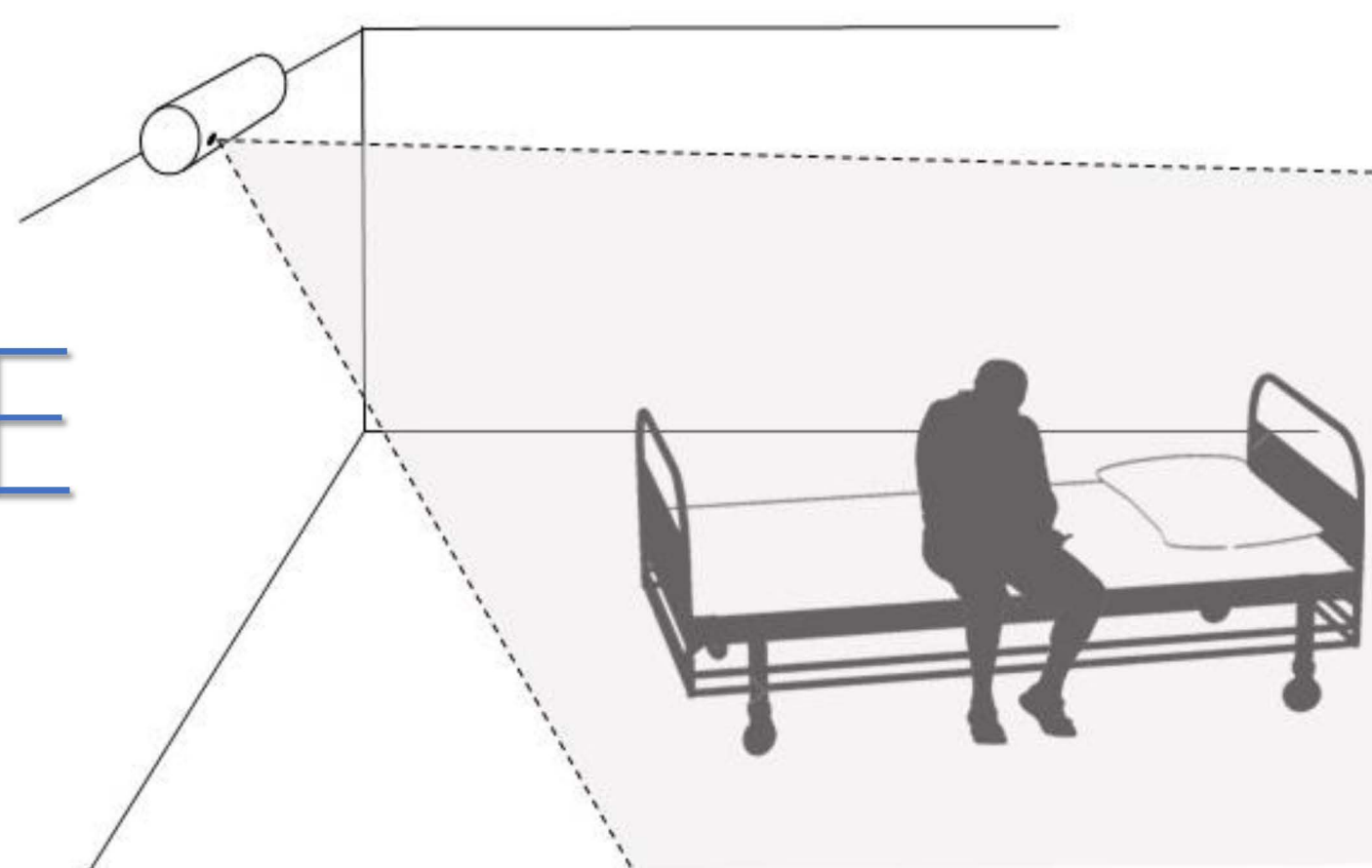- Non-intrusive
- Continuous surveillance
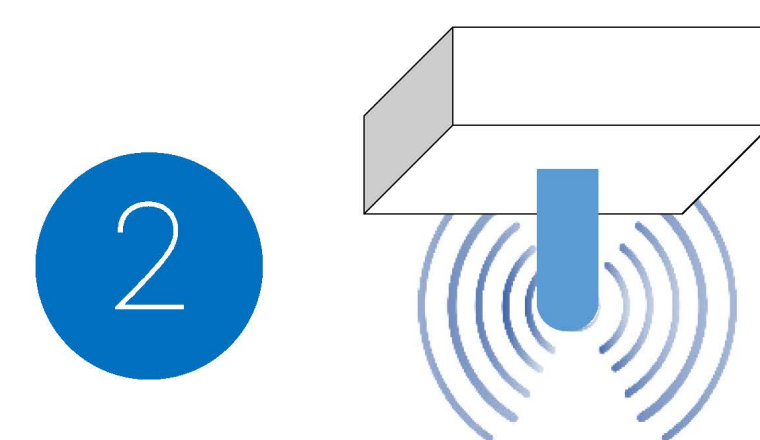

PreSAGE Device

Sample Thermography Image

Privacy-Ensured

- No distinguishable facial features.
- Preserves patient's privacy – an important feature in a healthcare institution.

1 PreSAGE is mounted on ceilings, providing continuous, non-intrusive monitoring of patients and their environment.

How PreSAGE Works

2 A visual and audio alarm is triggered when a bed-exit is predicted.

3 The care team responds early, and provides the necessary intervention.

Technology Collaborator:

CoNEX
HEALTHCARE PTE LTD

Supported by:

CMT
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