

ABSTRACT

Based on data from the UN (United Nations), it is predicted that the world's elderly population will reach 1.4 billion people in 2030. The elderly people tend to be fragile and easily injured. Falls and pressure injuries are conditions that often cause injuries to the elderly. Nearly 50% of falls in the elderly occur during walking conditions and 50% occur due to standing conditions. Apart from these two conditions, fall occurrences in the elderly are mostly in the toilet. Falling while walking can often cause large-scale TBI (Traumatic Brain Injury) in the elderly, compared to falling during standing pose. Incidence of pressure ulcer (PU) usually occurs due to unchanged/static sleeping position in an extensive period causing skin friction and increased temperature. The worst risk of PU is that it can create open perforated wounds on the skin and often occurs in the elderly with disabilities. If these two incidents are not handled immediately, they can cause trauma and take a long rehabilitation process.

There are many techniques and methods for handling falls such as acceleration sensors, wearable devices, radar, and vision utilizing thresholding classification techniques, machine learning (ML), or even deep learning (DL) techniques for sequence learning. The use of thresholding techniques is prone to false alarms compared to ML and DL techniques. It is noted that PU treatment is usually carried out by a nurse by changing the elderly body position every two hours while he/she is sleeping. Alternatively, the nurse can also encourage the elderly to sit periodically. Lastly, providing special cushions on either the bed or seat can also help the elderly.

To address these problems, an elder care system is proposed consisting of two main subsystems, i.e., indoor and outdoor. The indoor subsystem comprises two sub-systems, namely a monitoring subsystem with a camera for activity recognition and a mechanical bed to assist rehabilitation of the elderly with disabilities. Through the latter solution, mechanical bed, injuries can be prevented by changing the sleeping position of the elderly more easily, equipped with a mobile application as a user interface for the mechanical bed. On the other hand, the outdoor subsystem provides activities monitoring for walking and falling (moving conditions), as well as activities such as stable and unstable while standing still. Activity recognition uses an IMU (Inertia Measurement Unit) sensor, as well as GPS tracking and location photo features.

Evaluating the indoor subsystems, an activity monitoring system with a camera employing both Blaze-Pose and LSTM method provides a detection accuracy beyond 90%. Meanwhile, the mechanical bed sub-system in the indoor subsystem has an adequate accuracy with a percentage of error less than 1% for each different position and load. While on the other hand, the outdoor subsystem produces 100% accuracy for each activity recognition using IMU sensors and ANN for sequence learning. Meanwhile, the GPS location set on an outdoor system has a precise location set and location photos with a delay of more than 20s for sending to the database.

Keywords: Elderly, Fall, Pressure Ulcer, Human Activity Recognitions