Real-time Fall Detection System for the Elderly Using Deep Learning and Thermal Imaging

Vel, Vetri (School: Bangor High School)

Falls are the leading cause of fatal injury among older adults with over 12 million falls in the United States annually. For elderly people living alone, quick assistance after a fall is critical and can reduce hospitalization rate by 26% and death rate by 80%. The research goal of this study was to develop an unobtrusive wall-mounted embedded system for real-time fall detection since many elderly individuals prefer not to wear medical alert systems or may be unable to use them if injured after a fall. Deep learning was implemented on an inexpensive Raspberry Pi microcomputer to analyze and classify thermal images because of its effectiveness for pattern recognition. The embedded system utilizes thermal imaging to preserve privacy while detecting the heat signatures of humans. The system uses a set of thermal images to train a convolutional neural network to recognize images of fallen individuals in real-time. The effects of factors including image resolution and number of training images on the accuracy of the neural networks were investigated. An average accuracy of 98.8% (SD 2.6%, n=10) was achieved even in the presence of non-human heat sources. A functioning system has been developed to accurately detect falls and immediately call for help, potentially increasing the safety and independence of elderly people living alone at home or in assisted living facilities. The embedded system could also be used for other applications such as monitoring the night-time activity and sleep patterns of autistic children for safety if trained with different sets of images.

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