Chapter 78
Fall Behavior Recognition Based on Deep Learning and Image Processing

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ABSTRACT

Accidental fall detection for the elderly who live alone can minimize the risk of death and injuries. In this article, we present a new fall detection method based on "deep learning and image, where a human body recognition model-DeeperCut is used. First, a camera is used to get the detection source data, and then the video is split into images which can be input into DeeperCut model. The human key point data in the output map and the label of the pictures are used as training data to input into the fall detection neural network. The output model then judges the fall of the subsequent pictures. In addition, the fall detection system is designed and implemented with using Raspberry Pi hardware in a local network environment. The presented method obtains a 100% fall detection rate in the experimental environment. The false positive rate on the test set is around 1.95% which is very low and can be ignored because this will be checked by using SMS, WeChat and other SNS tools to confirm falls. Experimental results show that the proposed fall behavior recognition is effective and feasible to be deployed in home environment.

1. INTRODUCTION

The world is facing an alarming rate of aging. Europe first entered an aging society, of which Germany was called the "European Nursing Home" (Regnier, 1994; Lukas et al., 2013). In China, it is estimated that the number of elderly people over the age of 60 will increase to around 2.55 billion by 2020, accounting for 17.8% of the total population; the number of elderly will increase to 29 million, and the number of

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elderly who is living alone will increase to 1.18 billion; at the same time, the elderly dependency ratio which is defined as the number of elderly people born per 100 working-age population will increase to about 28%. Figure 1 shows the statistical data of elderly in China. Fall detection of the elderly is a major public health problem (Noury et al., 2007). If the fall occurs without timely rescue will result in rising medical costs and increasing demands for healthcare services. Research by Iio et al. (2016) shows that timely rescue of the elderly after a fall can effectively reduce the risk of death by 80% and the risk of long-term hospitalization by 26%. With the development of Internet of Things (IoT) technology (Gubbi et al., 2013), many sensors-based methods are proposed for the elderly healthcare and security (Suryadevara & Mukhopadhyay, 2012; Ferreira et al., 2018; Hernández-Penaloza et al., 2018). Elderly populations are more prone to benefits from using wearable devices (Kekade et al., 2018), but those devices are attached to the users, and result in uneasiness or discomfort while wearing them in public areas (Fang et al., 2016). Comfortable wearing feel and wearing mobility are the important issues for wearable devices to be used in helping the elderly (Morizono, Oda, Motomura, Sakamoto, Takeshita & Matsubara, 2016; Wang, Yang & Dong, 2017).

Ambient intelligence (AmI) is also important and helpful for improving quality of life (Obukata, Cuka, Elmazi, Oda, Ikeda & Barolli, 2017) and improving health for elderly (Campos et al., 2016). Lotfi et al. (2017) proposed an ambient assisted living platform to help the carers and the elderly person. De

Figure 1. Statistical data of elderly in China