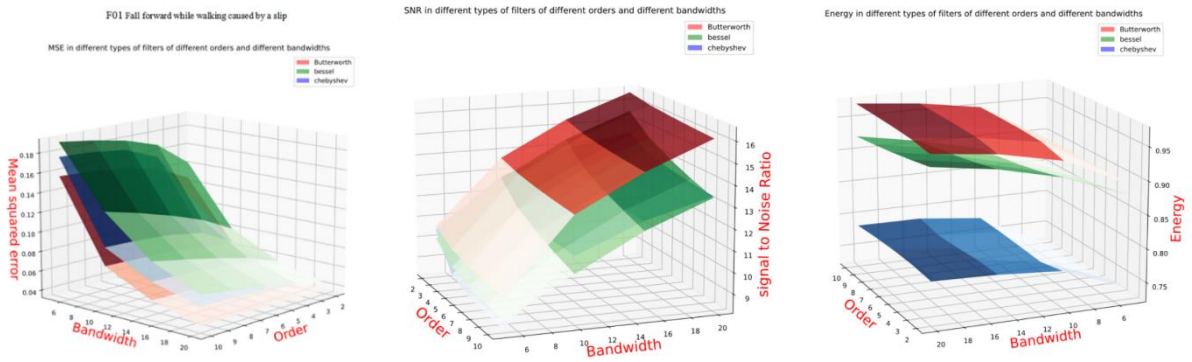

Figure 3 – Comparison of different metrics of different filters under different orders and different bandwidths of Fall

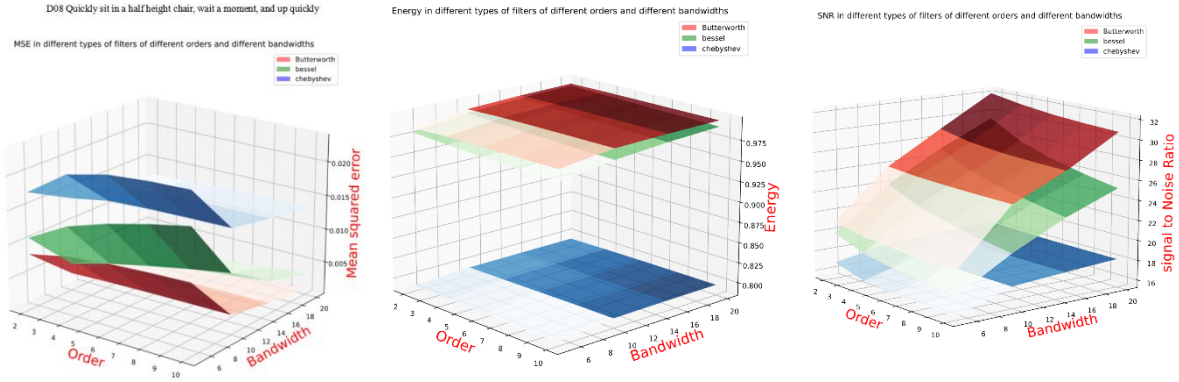

Figure 4 – Comparison of different metrics of different filters under different orders and different bandwidths of ADLs

From fig. 3 and fig. 4, we can see that the Butterworth filter is always optimal under different metrics and different parameters. So we chose the Butterworth filter as the best filter for the data preprocessing stage.

УДК 338

MULTIPLE SENSORS

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Summary. *The paper discusses an advanced human fall detection algorithm that utilizes data from multiple sensors, specifically acceleration sensors and video sensors, to enhance fall risk management for high-risk groups like the elderly and those with limited mobility. The key innovation in this research is the integration of multiple sensors, which enhances the accuracy and reliability in differentiating between genuine falls and non-fall activities. This advancement significantly enhances the safety of individuals who are at a high risk of falling.*

Due to the impact of global pandemics and the aging population issue, fall injuries have become a primary cause of accidental harm for both underlying patients and the elderly. While many video sensors and acceleration sensors have

been used to detect human falls, most of them rely on transmitting sensed video or sensor data over the network to cloud servers, where complex computations are performed. However, the emphasis in fall detection algorithms lies in real-time responsiveness and accuracy, and many existing algorithms prioritize accuracy while neglecting the crucial factor of real-time responsiveness.

In recent years, people have invented many devices to detect and report instances of people falling. These devices can be broadly categorized into wearable systems and image recognition systems. Wearable devices can sometimes be inconvenient to wear and require charging. Depending on the placement and usage conditions, these devices may exhibit non-uniform accuracy. Because fall detection involves significant computation, image recognition systems must transmit images or videos to cloud computing platforms, which may lead to privacy concerns.

To develop the algorithm for the proposed model, the Sisfall public dataset was used. The Sisfall dataset comprises 15 instances of falls and 19 instances of Activities of Daily Living (ADL) performed by 38 subjects with sensors attached to their waist. Among other publicly available datasets, Sisfall stands out because it includes pre-staged falls and daily life activities (ADL) of elderly individuals.We use threshold selection based on boxplot to select the best threshold from multiple features. After experiments (table 1), we select Norm_hori (acceleration on the horizontal plane), Norm_xyz (total acceleration), and angle as threshold features.

Table 1 – The accuracy of fall detection based on threshold

Threshold features	Sensitivity	specificity	accuracy	Unidentified
Norm_hori	88 %	97.46 %	92.85 %	0
Norm_xyz	53.33 %	97.46 %	75.97 %	0.00 %
Norm_hori + Norm_xyz	48 %	97.46 %	73.37 %	22.08 %
Norm_hori + angle	88 %	97.46 %	92.85 %	2.50 %
Norm_xyz + angle	53.33 %	97.46 %	75.97 %	20.77 %
Norm_hori Norm_xyz + angle	93.33 %	97.46 %	95.45 %	1.30 %
Norm_z + Norm_zhori	100 %	5.06 %	51.29 %	0.00 %

We first choose the time window of the unknown time series for sensor data analysis, optimize the posture estimation model for faster human target detection and joint point reasoning. We use human posture joint point image data and integrate it with existing fall models to identify falls. The human fall detection models are divided into 8 categories: walking (standing), running, sitting down, squatting, falling to the right, falling to the left, falling backward, and falling forward, as shown in fig. 1. When any of the four falling categories occur (falling to the right, falling to the left, falling backward, or falling forward), the device detects a fall.

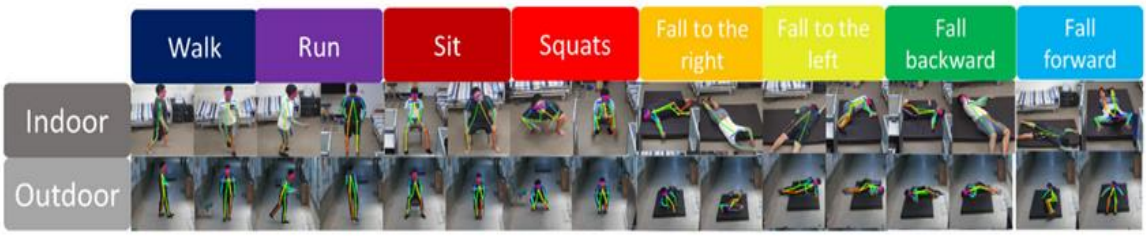

Figure 1 – Fall action display

When testing videos, this article first tests a single person on a monotonous background, as shown in fig. 2. the algorithm in this paper can clearly identify the state of the person being detected at the time of detection under a monotonous background, and promptly mark the fall status in red before uploading.

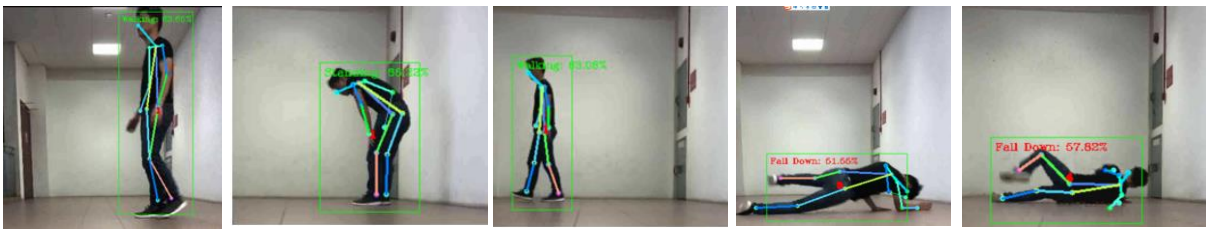

Figure 2 – Fall detection results based on video sensors

The population is aging seriously, and the number of elderly people living alone is increasing. In order to improve the behavioral safety of the elderly and basic patients when they live at home and move alone, this article proposes a fall behavior detection algorithm based on multiple sensors. This algorithm combines the optimization and acceleration of the video sensor human detection model and human posture detection model by analyzing sensor acceleration data, and uses human posture data to build a fall detection algorithm. This algorithm makes the response mechanism after a fall more efficient. At the same time, the experimental results show that the detection algorithm has high real-time performance and accuracy, and can quickly detect the fall behavior of the detected person online.

УДК 658.7

STUDY ON THE TREND OF DIGITAL TRANSFORMATION IN THE LOGISTICS INDUSTRY

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Summary. *The digital transformation of the logistics industry cannot be postponed as the scale of the digital economy grows. This paper proposes ten innovative trends based on this.*

Digital transformation is a comprehensive transformation and upgrading of processes, organizations, business models, and other aspects of the enterprise, and