

Fall Risk Prediction Model

墜落風險預測模型

System Integration Delivery Document

系統整合交付文件

1. Purpose of the Model

1. 模型的目的

This model is designed to estimate **fall risk probability** of a person based on short-term temporal visual information captured by a fixed camera.

此模型旨在根據 固定攝影機捕捉的短期時間視覺資訊，估算個人跌倒風險的機率。

The output is a **continuous probability (0–1)** indicating the likelihood that the person is in a fall or high-risk state, rather than a hard binary decision.

輸出為連續機率（0–1），表示該人處於跌倒或高風險狀態的可能性，而非硬性二元決策。

The model is intended for **real-time deployment in medical or care facilities**, where it works in conjunction with a human detection / pose estimation system.

此模型旨在即時部署於醫療或照護機構，並與人類偵測/姿態估計系統協同運作。

2. System Role Definition

2. 系統角色定義

This project adopts a **modular system architecture**:

本專案採用模組化系統架構：

System Team

系統團隊

Camera setup

攝影機設置

YOLO-based person detection / pose estimation

基於 YOLO 的人物偵測/姿勢估計

Person tracking and UI visualization

人物追蹤與使用者介面視覺化

Fall Risk Model (this work)

墜落風險模型（本研究）

Temporal fall risk inference based on image sequences

基於影像序列的時間墜落風險推論

Outputs per-person fall probability

輸出：每人跌倒機率

This separation ensures flexibility, maintainability, and scalability.

這種分離確保了彈性、可維護性與可擴展性。

3. Model Input Specification

3. 模型輸入規格

The model expects the following input format:

模型預期輸入格式如下：

Input shape:

輸入形狀：

(1, 30, 64, 64, 3)

Description:

說明：

30 consecutive RGB frames of a single person

連續 30 個單一人物的 RGB 畫面

Each frame is a cropped person region (ROI)

每個畫面都是一個裁切過的人物區域 (ROI)

Frames are resized to **64 × 64**

框架尺寸調整為 **64×64**

Pixel values normalized to **[0, 1]**

像素值正規化為 **[0 , 1]**

Temporal logic:

時間邏輯 :

Frames are collected using a **sliding window**

框架透過滑動窗收集

One prediction corresponds to one temporal window

一個預測對應一個時間窗口

4. Model Output Specification

4. 模型輸出規格

Output:

輸出 :

Single scalar value $\in [0, 1]$

單純量值 $\in [0 , 1]$

Meaning:

意思 :

Fall risk probability

墜落風險機率

Decision usage:

決策用途 :

Threshold (e.g., 0.5) can be adjusted by the system side

閾值 (例如0.5) 可由系統端調整

Probability can be visualized directly or used for alerts

機率可以直接視覺化或用於警示

5. Provided Files

5. 提供的檔案

The following files are delivered for system integration:

以下檔案提供供系統整合使用：

fall_cnn_gru.keras

(Primary model for deployment)

(主要部署模型)

fall_cnn_lstm.keras

(Alternative temporal model for comparison)

(作為比較的替代時間模型)

This integration document

此整合文件

Optional inference code examples can be provided upon request.

可依需求提供可選的推論程式碼範例。

6. Deployment Notes

6. 部署備註

The model performs inference **per person**, not per frame

該模型是針對每個人進行推論，而非每幀

Multiple persons can be processed independently

多人可以獨立處理

Designed for continuous real-time evaluation

設計用於持續即時評估