HUMAN FALL DETECTION SYSTEM USING DEEP LEARNING

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INTRODUCTION

BACKGROUND & MOTIVATION

Increased Risk of Falls:

As the aging population grows, so does the risk of accidental falls, with fall rates among the elderly being significantly high. Specifically, those aged 65 and above experience fall rates ranging from 28% to 35%, and this percentage escalates to 32% to 42% for individuals over 70.

1

Global population ageing trends

Citing a 2015 World Health Organization report, the number of individuals aged 60 and above is projected to double by 2050.

2

3

Importance of Fall Detection Systems

The development of reliable and effective fall detection systems is important for improving the quality of life of older adults.

OBJECTIVES

OpenPose with Yolo

ResNet with Channel and Spatial Attention

Kai_cnn

Fall/Not Fall

BACKGROUND REVIEW

Researchers	Frameworks	Feature Extraction	Performance
BO-HUA WANG et al.	Yolo+OpenPose	MLP + Random Forest	Accuracy≈97.33%
SARDOR JURAEV et al.	AlphaPose	Transformer	Accuracy=89.22%
THAVAVEL VAIYAPURI et al.	SSO+SqueezeNet	SSOA-VAE	Accuracy=99.76%
Yinlong Zhang et al.	Openpose	VGG-19	Accuracy=96%

Table 1. Summary of representative methods for skeleton-based fall detection system.

APPLICATION OF OPENPOSE AND YOLO MODELS

OpenPose in human pose estimation

OpenPose is a real-time multiplayer 2D human pose recognition technology, which can accurately capture the key points of the human body in videos or pictures.

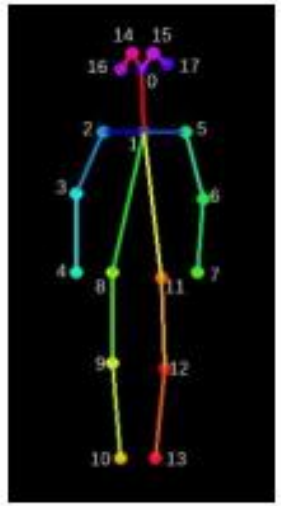
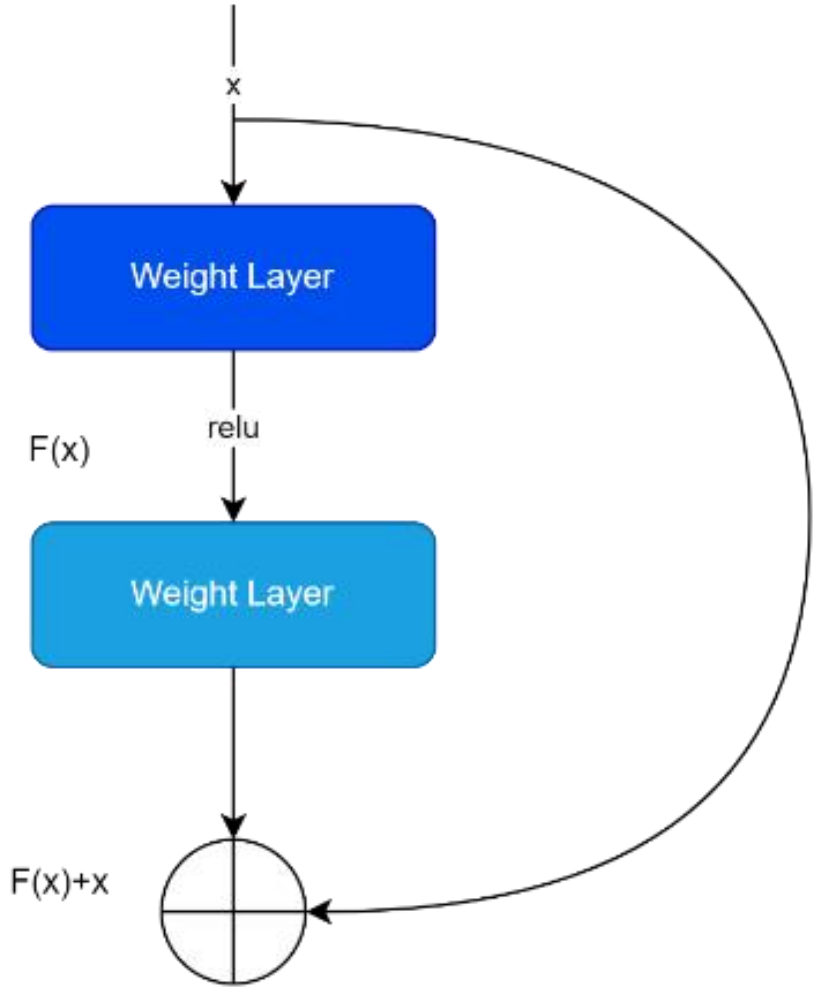


FIGURE 6. Human structure extracted by OpenPose.

YOLO model in target detection

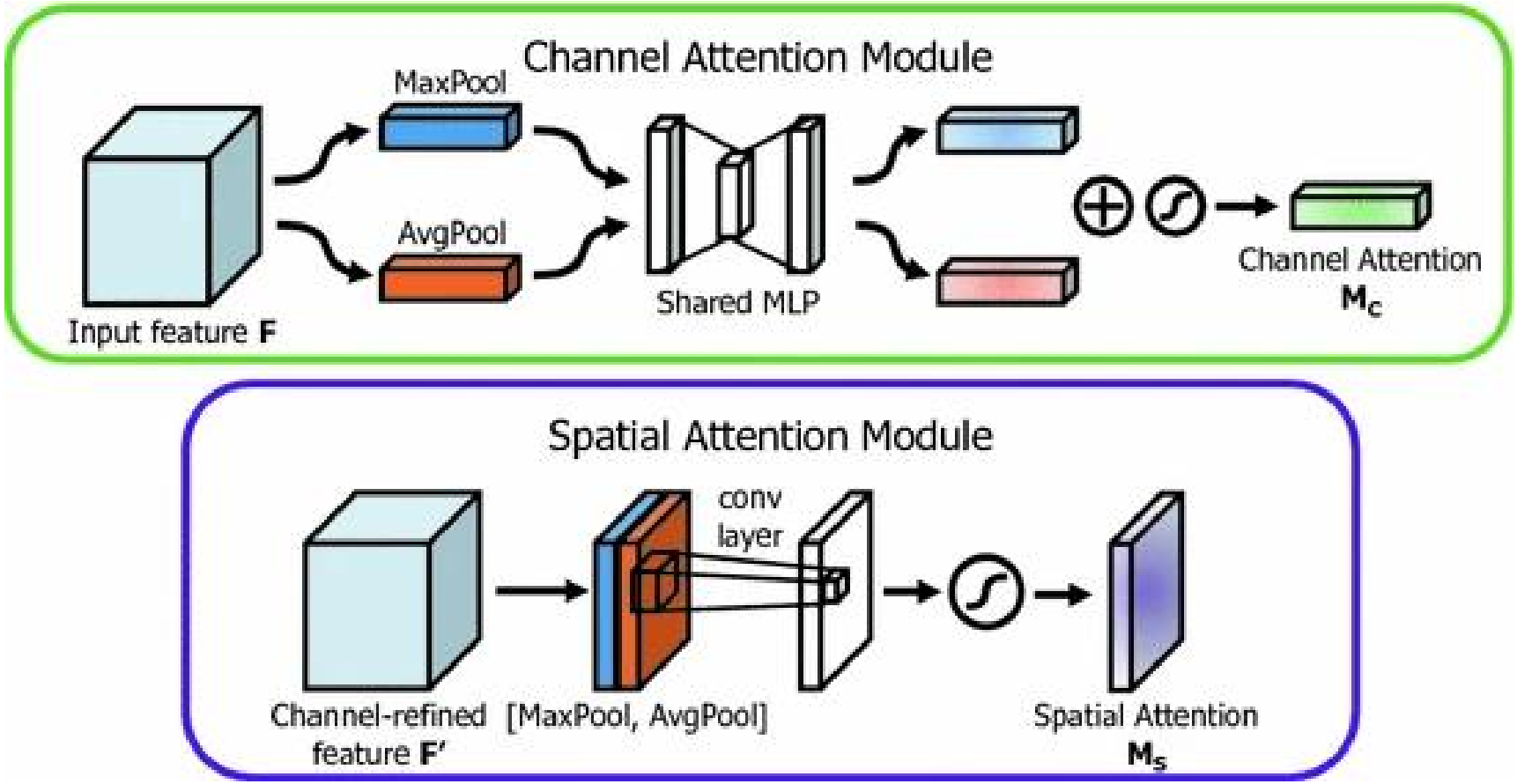
The YOLO (You Only Look Once) model is known for its efficient target detection capability, which realizes fast and accurate target detection by predicting the category and position of objects at once.

RESNET



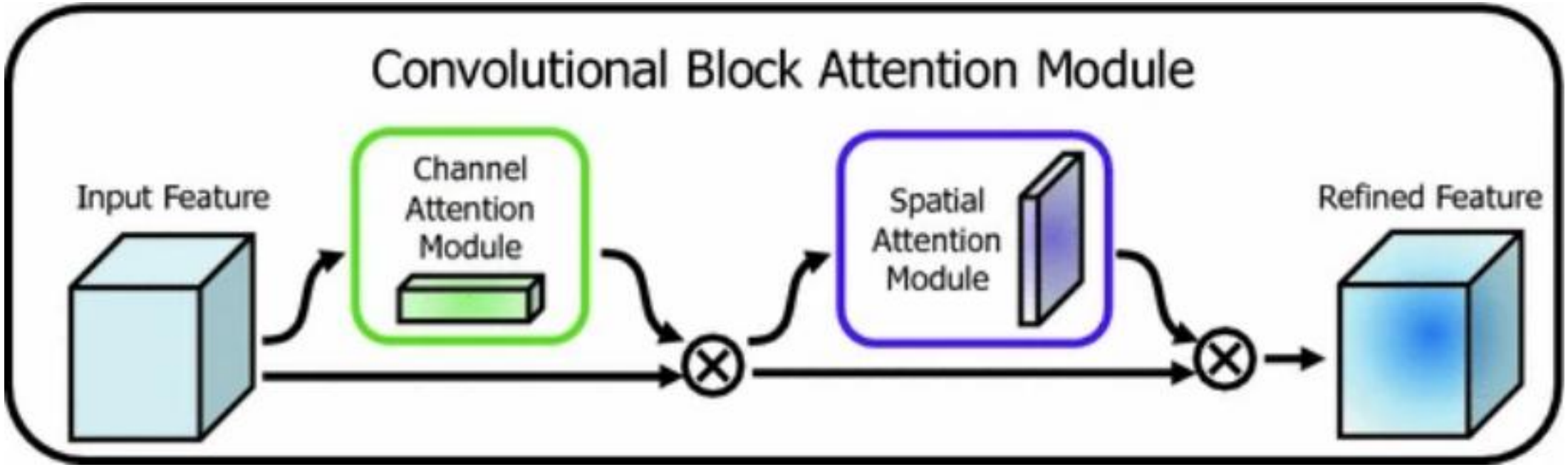
A residual block with skip connection

ATTENTIONAL MECHANISMS



Channel Attention and Spatial Attention Module

ATTENTIONAL MECHANISMS: CBAM



Convolutional Block Attention Module

METHDOLOGY

TECHNOLOGY

Component	Specification	Role
RAM	16 GB of Random Access Memory	Efficient data handling and model training
GPU	Nvidia GeForce RTX 2060 GPU	High-performance computation for deep learning tasks
CPU	Intel® Core™ i7-10875H CPU	Processing power for data preprocessing and model training

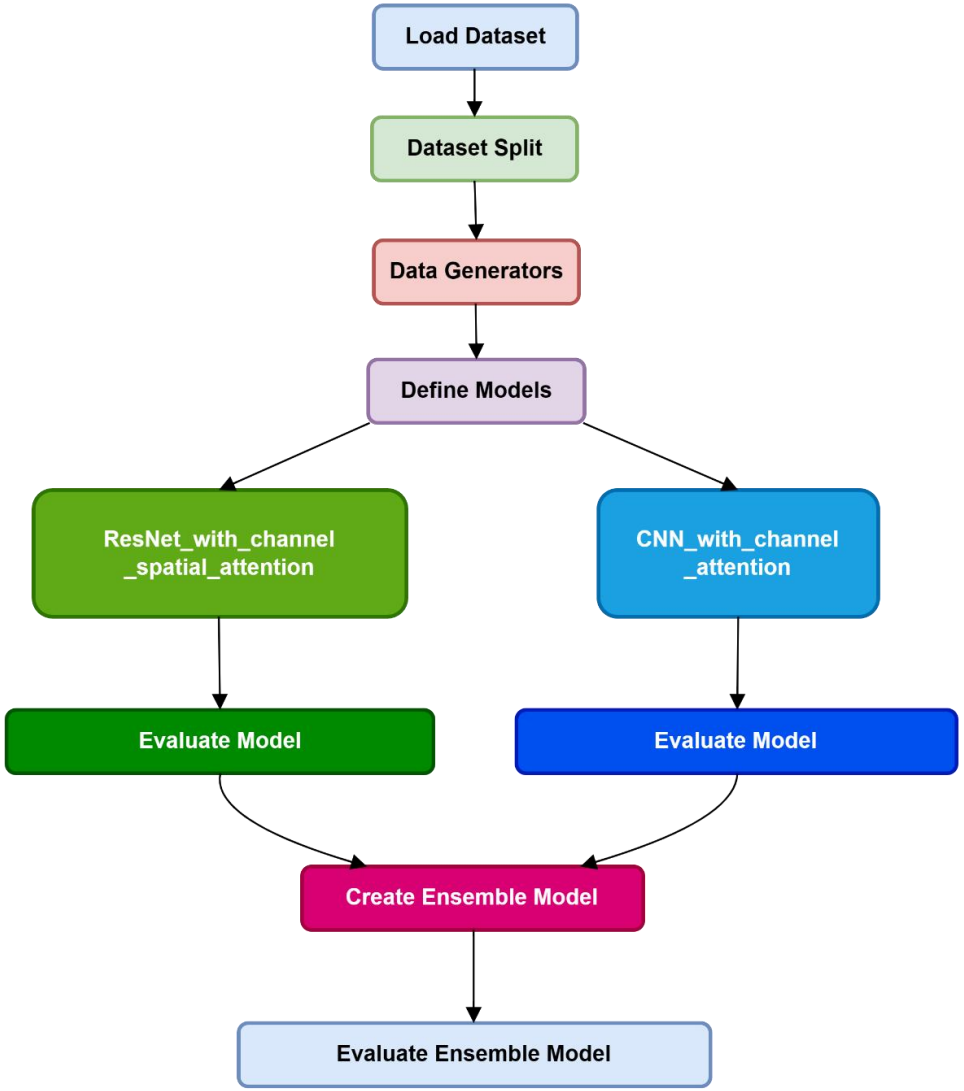
Table 2. Hardware

TECHNOLOGY

Tool/Language	Description	Usage
Operating System	Windows-based system	Platform for model development and testing
Deep Learning Framework	TensorFlow	Framework for constructing and training neural networks
Data Processing Libraries	NumPy and Pandas	Efficient array operations and data manipulation
Data Visualization Tools	Matplotlib and Seaborn	Plotting and statistical chart creation
Model Building Tool	Keras	User-friendly interface for constructing neural networks
Machine Learning Libraries	Scikit-learn	Algorithms and metrics for model evaluation
Image Processing Library	OpenCV	Computer vision tasks and image processing

Table 2. Software

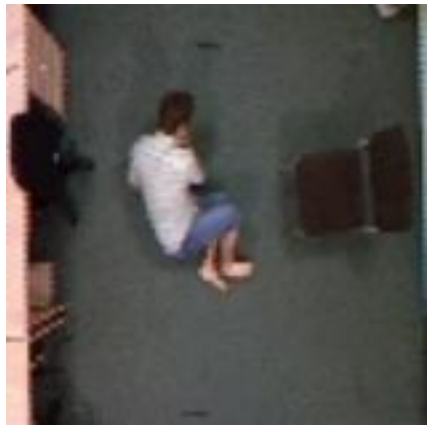
WHOLE PROCESS OF THE WORKFLOW

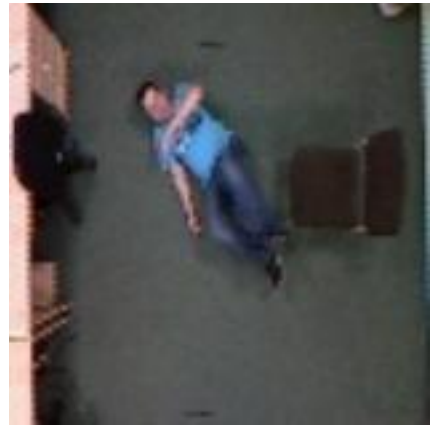


DATASET SPLIT

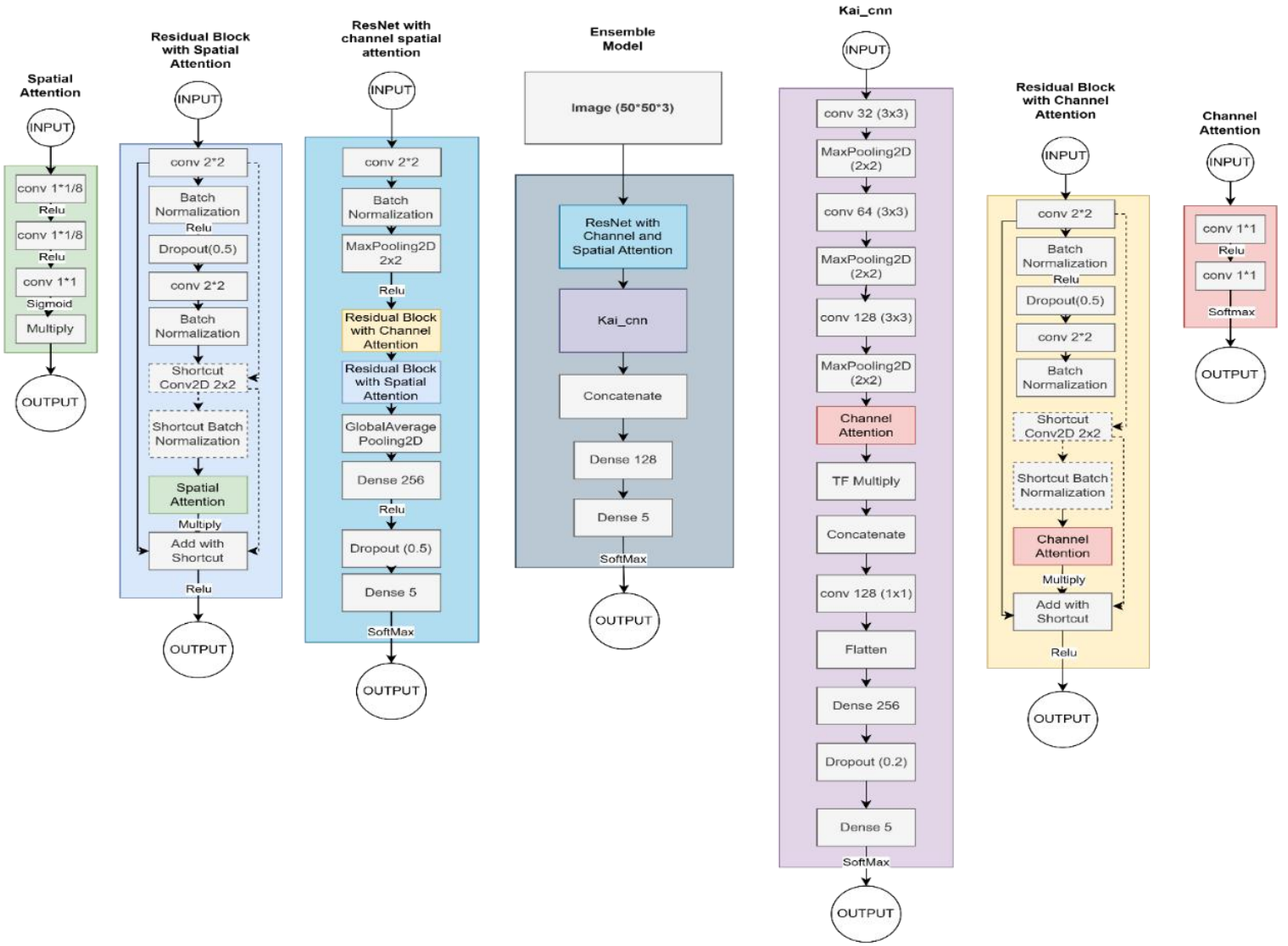
Train images	Valid images	Test images
909	202	51



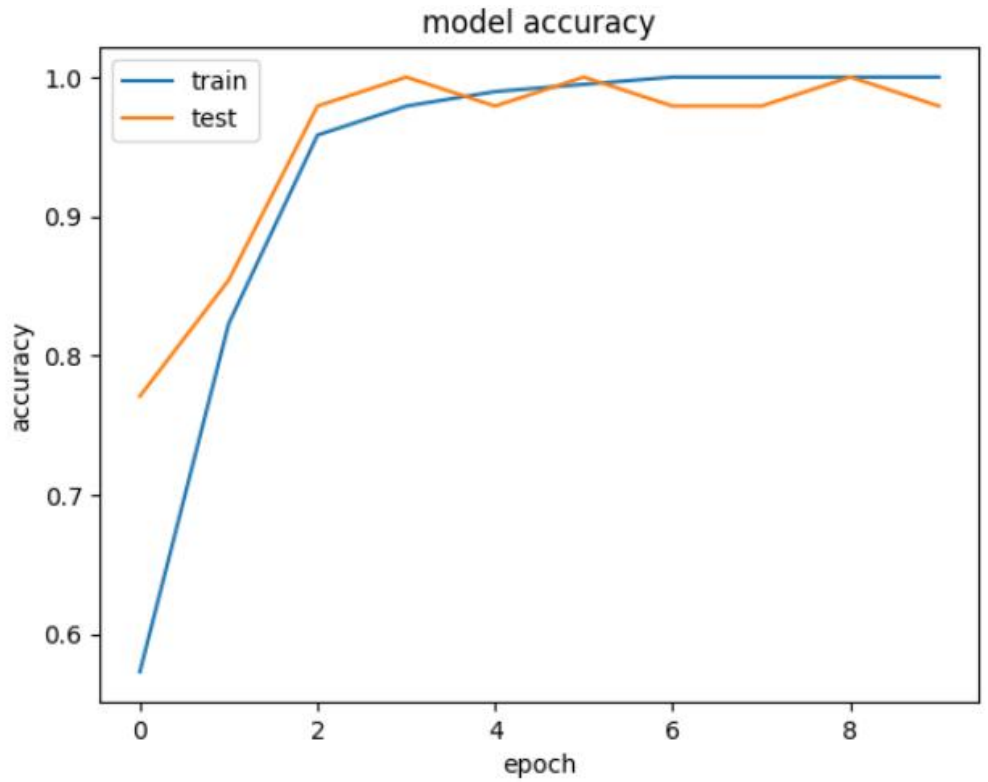


MODEL STRUCTURE

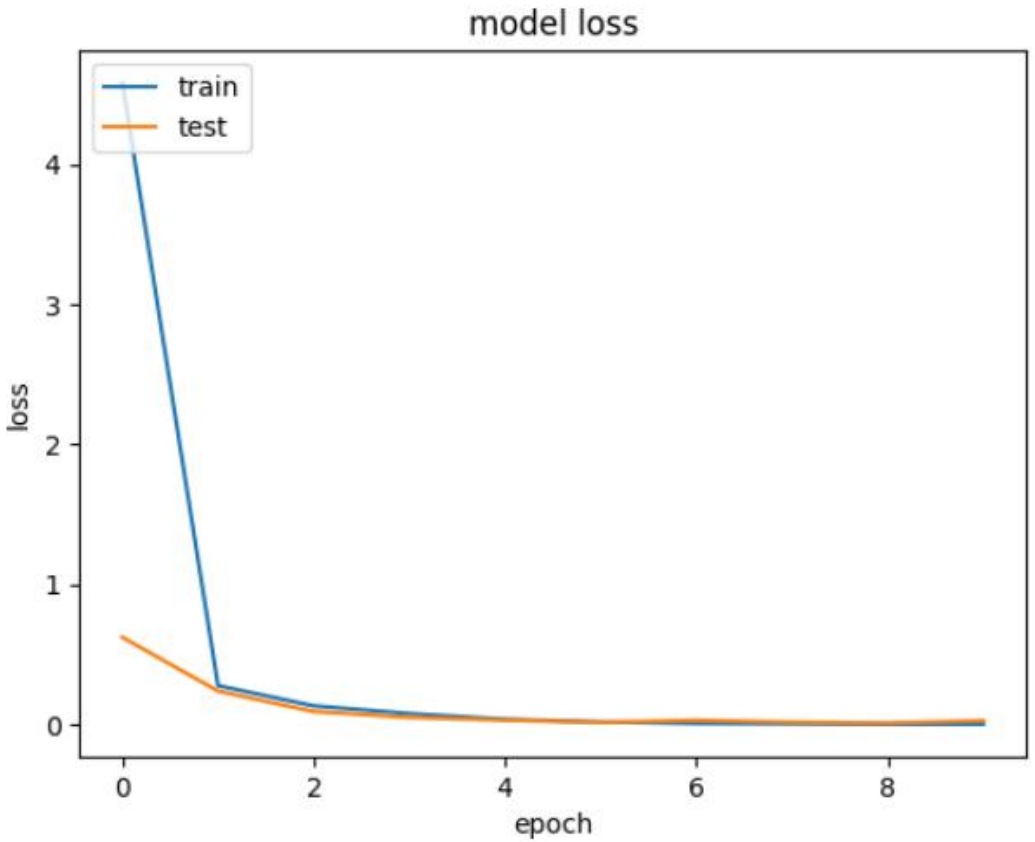


PROJECT IMPLEMENTATION & RESULTS

ENSEMBLE MODEL PERFORMANCE

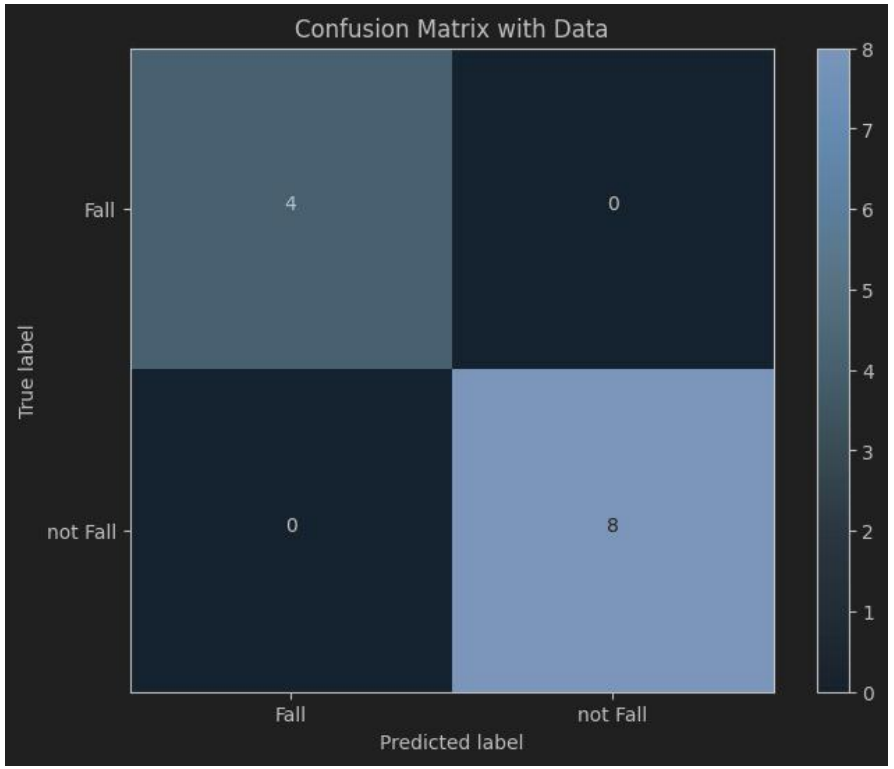


Accuracy



Loss

ENSEMBLE MODEL PERFORMANCE

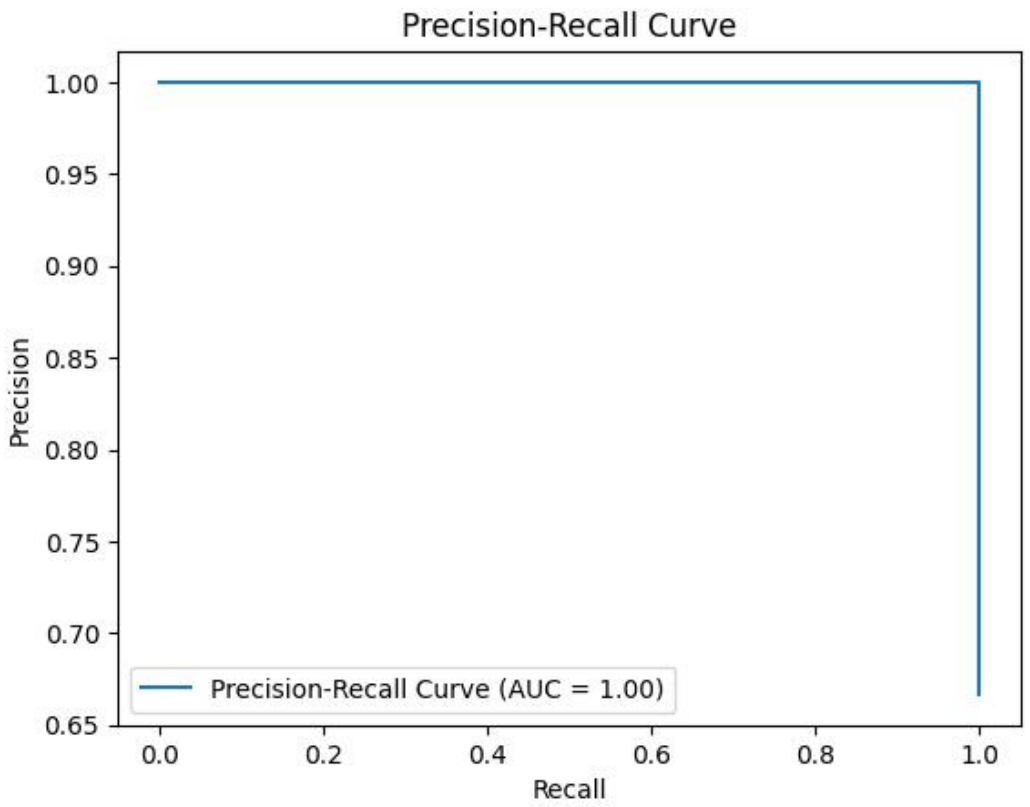


Confusion Matrix

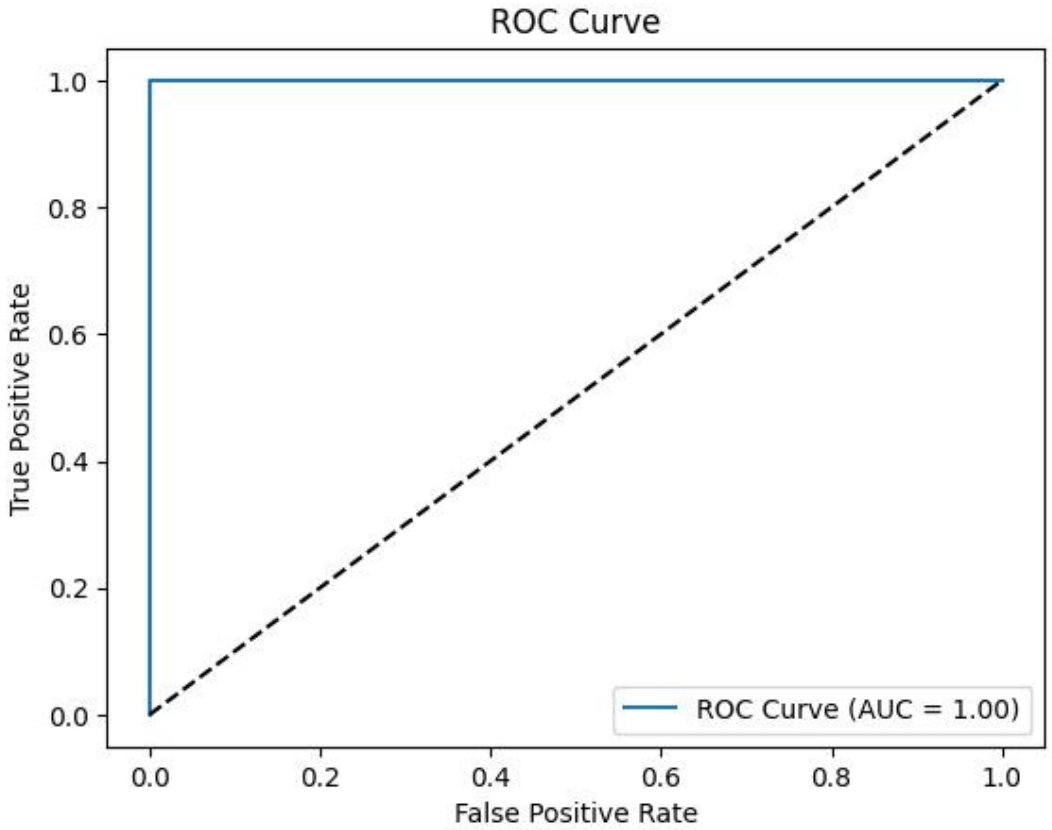
Sensitivity(Recall)	Specificity
1.0	1.0

Sensitivity and Specificity

ENSEMBLE MODEL PERFORMANCE

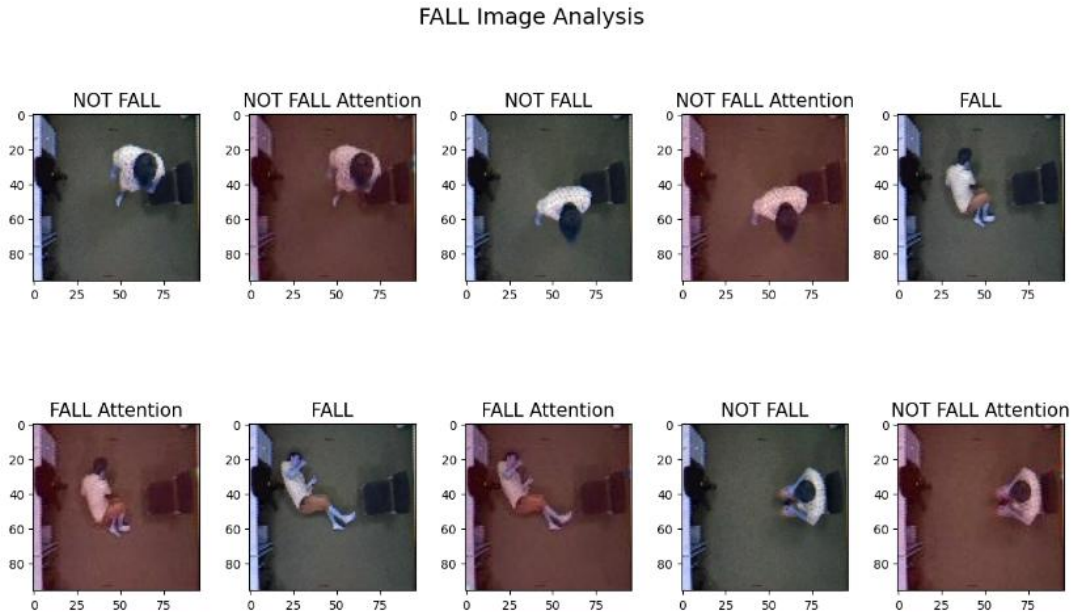


Precision-Recall Curve

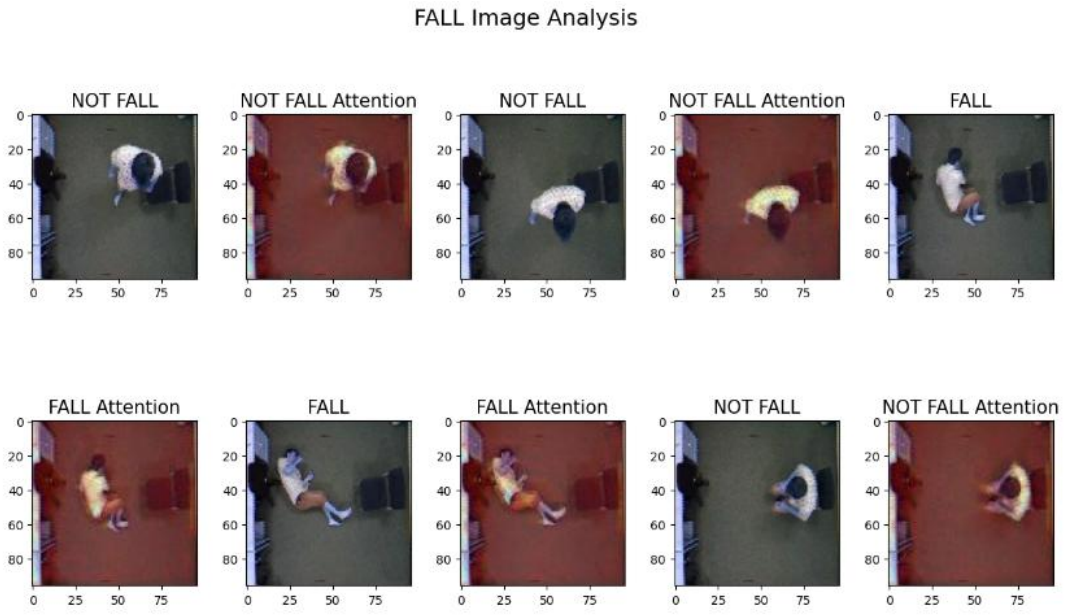


ROC-AUC Curve

MODEL 1 : GRAD-CAM (RESNET WITH CHANNEL AND SPATIAL ATTENTION)

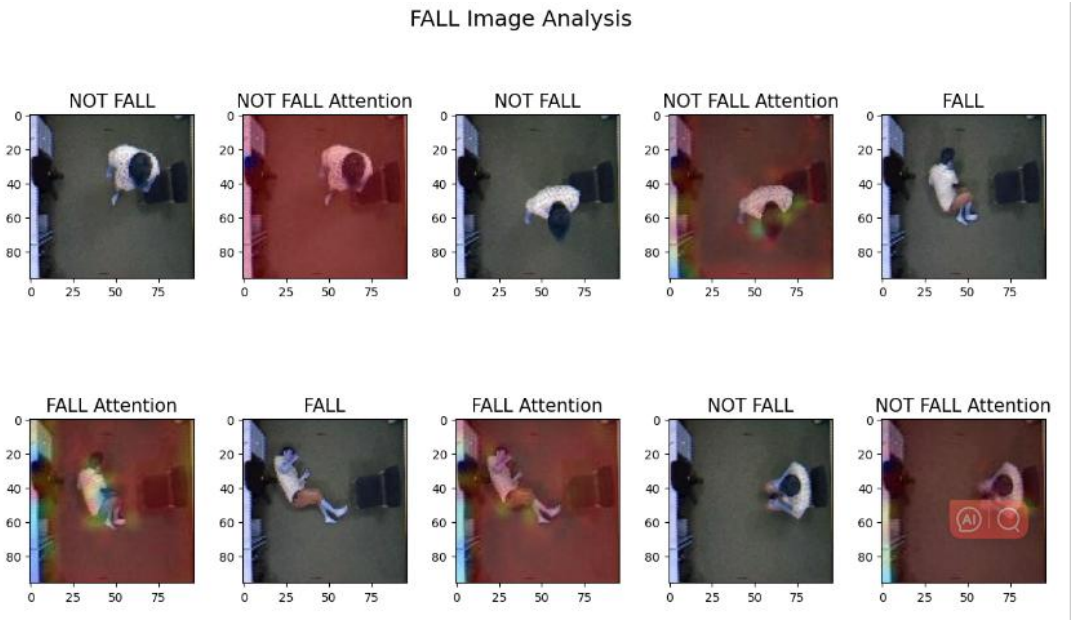


Grad-CAM without attention mechanism

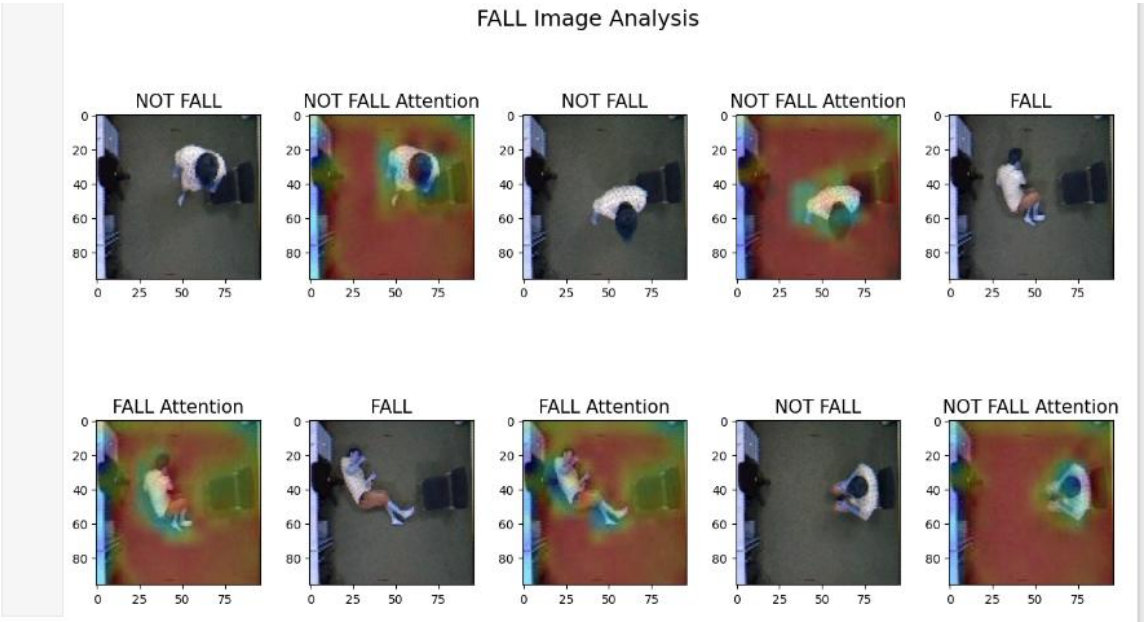


Grad-CAM with attention mechanism

MODEL 2: GRAD-CAM (KAI_CNN)

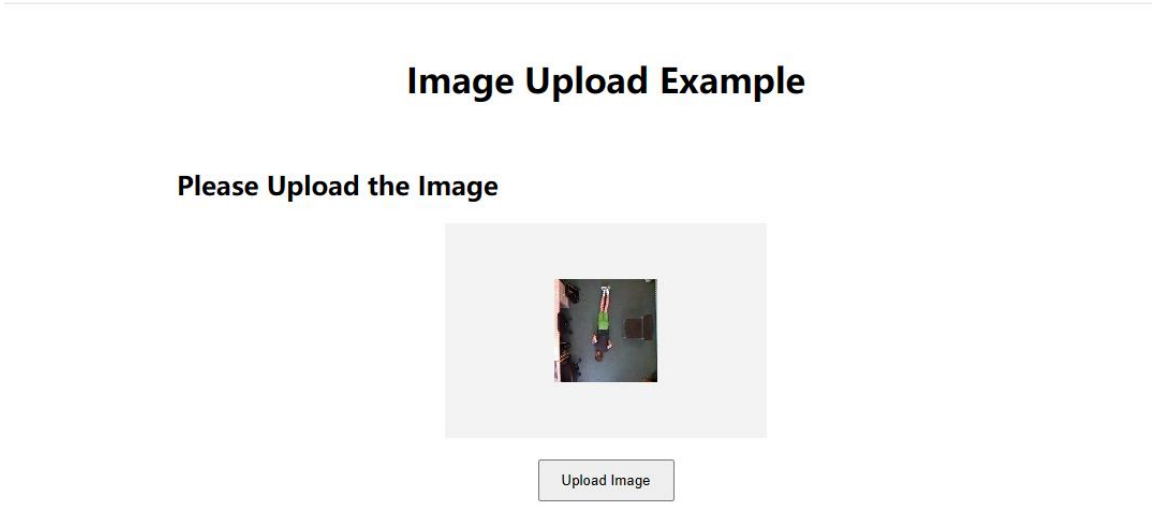


Grad-CAM without attention mechanism

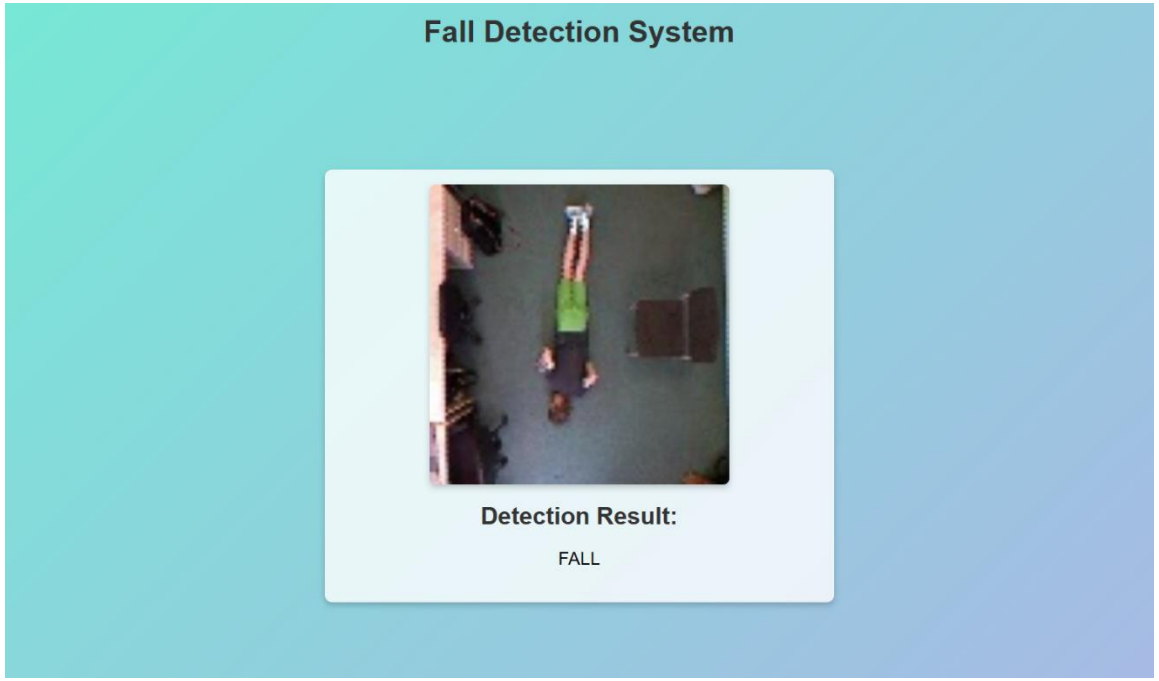


Grad-CAM with attention mechanism

UI DESIGN



Upload Image UI



Detection Result

LIMITATIONS AND CHALLENGES

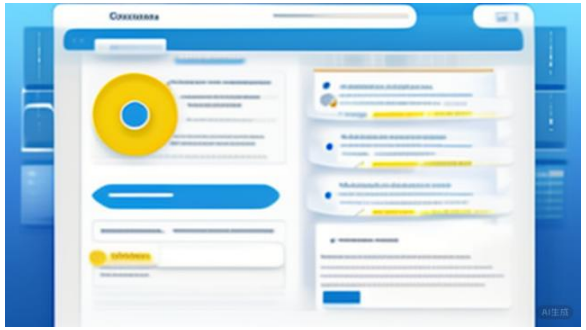
The Effect of Illumination on Image Recognition

Changes in lighting conditions can directly affect the quality of the image, and too much or too little light can lead to a loss of image detail, making it difficult to accurately identify the target object.

The Challenge of Background Interference

In a complex background, irrelevant objects and noise may be confused with the target object, increasing the difficulty of image recognition.

CONCLUSION AND FUTURE WORK



Fall Detection System Development

Successfully developed a bone-based fall detection system, which utilizes computer vision techniques to capture human postures and combines deep learning to construct a convolutional neural network model, which demonstrated an accuracy rate of up to 99.03%

User Interface and Results Presentation

The system design focuses on user experience, providing a simple and easy-to-use interface that allows users to easily upload images for testing and present the results in a clear and intuitive way.

THANK YOU !