National College of Ireland

Configuration Manual

MSc Research Project

Msc in Data Analytics

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MSc Project Submission Sheet

School of Computing

Student Name:	Yogesh savulla .....
Student ID:	23322004 .....
Programme:	Masters of science in Data Analytics ..... **Year:** .....2025..... .....
Module:	Msc research Project .....
Lecturer:	David Hamill .....
Submission Due Date:	11 August 2025 .....
Project Title:	.....
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Configuration Manual

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1 Overview

This project implements a hybrid Convolutional + Transformer Video Autoencoder with a LightGBM meta-classifier for detecting anomalies in crowd surveillance footage. The system is designed for:

- Accuracy : Detecting appearance and motion anomalies in video streams.
- Efficiency : Operating at 128×128 resolution for real-time inference.
- Robustness : Using multiple reconstruction/perceptual metrics instead of brittle thresholds (Cavallaro et al., 2023).
- Scalability : Adaptable to different datasets and deployment environments.

2 Hardware Requirements

Component	Minimum Requirement	Recommended for Training
Processor	Intel i5 8th Gen / AMD Ryzen 5	Intel i7 12th Gen / AMD Ryzen 7
GPU	NVIDIA GTX 1060 (6 GB VRAM)	NVIDIA RTX 3080 (10 GB VRAM)
RAM	8 GB	16–32 GB
Storage	10 GB free (datasets, models, logs)	50 GB SSD
OS	Windows 10 / Ubuntu 20.04	Ubuntu 22.04 LTS

3 Software Requirements

Programming Language: Python 3.10+

Core Libraries:

- PyTorch 2.6.0 + cu124
- Torchvision 0.21.0
- OpenCV 4.11.0
- PIQ 0.8.0 (for SSIM, PSNR)
- LightGBM 4.6.0

- scikit-learn 1.2.2
- NumPy, Pandas, Matplotlib

Development Environment:

- Jupyter Notebook / Google Colab / VS Code

Version Control: Git

4 Dataset Configuration

Dataset Used: UCSD Anomaly Detection Dataset (Ped1 & Ped2)
Download Link: https://www.kaggle.com/datasets/orvile/ucsd-anomaly-dataset

Preprocessing Steps:

1. Extract frames from videos.
2. Resize frames to 128×128 pixels.
3. Normalize pixel values to [0, 1].
4. Create overlapping sequences of 5 frames, predicting the 6th frame.
5. Align ground truth anomaly masks with target frames(Chandra, 2025).

5 Installation Steps

Step 1 :Clone Repository

```
git clone https://github.com/username/crowd-anomaly-detection.git
cd crowd-anomaly-detection
```

Step 2 :Create Virtual Environment

```
python -m venv venv
source venv/bin/activate   # Linux/Mac
venv\Scripts\activate      # Windows
```

Step 3 :Install Dependencies

```
pip install -r requirements.txt
```

Step 4 :Download Dataset

```
kaggle datasets download -d orvile/ucsd-anomaly-dataset
unzip ucsd-anomaly-dataset.zip -d data/
```

6 Running the System

Train Model

```
python train.py --dataset_path data/ --epochs 30 --batch_size 8
```

Evaluate Model

python evaluate.py --dataset_path data/ --model_path saved_models/best_model.pth

Run on New Video

python predict.py --video_path sample_video.mp4 --model_path saved_models/best_model.pth

7 Output Structure

- **saved_models/** :Trained model weights (Dardour et al., 2025).
- **logs/** :Training and validation loss/metrics.
- **results/** :Generated anomaly maps and predictions.
- **plots/** :Graphs for reconstruction loss and feature importance.

8 Configuration Parameters

Parameter	Value	Description
Input Size	5×3×128×128	5 frames, RGB, resized to 128×128
Encoder Channels	32, 64, 128	Progressive feature extraction
Transformer Heads	4	Temporal attention modeling
Batch Size	8	Training batch size
Learning Rate	1e-4	Adam optimizer
Epochs	30	Max training cycles
Loss Function	MSE	Reconstruction loss
Classifier	LightGBM	Multi-metric anomaly classification

9 Maintenance & Extension

- **Dataset Expansion** :Add Avenue, ShanghaiTech, or Street Scene datasets for improved generalization.
- **Model Optimization** :Apply quantization/pruning for edge deployment.
- **Metric Addition** :Include optical flow-based metrics for motion-sensitive anomaly detection.
- **Explainability** :Integrate saliency maps for visual justification of anomalies (Dhar et al., 2025).

References

Cavallaro, C., Cutello, V., Pavone, M., & Zito, F. (2023). Discovering anomalies in big data: a review focused on the application of metaheuristics and machine learning techniques. *Frontiers in Big Data*, *6*. https://doi.org/10.3389/fdata.2023.1179625

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Dardour, A., Haji, E. E., & Begdouri, M. A. (2025). Video Surveillance and Artificial Intelligence for Urban Security in Smart Cities: A Review of a Selection of Empirical Studies from 2018 to 2024. *MDPI*, *10*(1), 15–15. https://doi.org/10.3390/cmsf2025010015

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