FACULTY OF ENGINEERING AND TECHNOLOGY

SCHOOL OF COMPUTING

DEPARTMENT OF COMPUTING TECHNOLOGIES

AY 2023- 24 EVEN

18CSE352T NEURO-FUZZY AND GENETIC PROGRAMMING

Case Study Implementation Report

Anomaly recognition from surveillance videos using 3D convolution neural network

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
Deemed to be University u/s 3 of UGC Act, 1956

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Objective:

1. Evaluation of Anomalous Activity Recognition Methods: The primary objective of the case study is to evaluate the effectiveness of anomalous activity recognition methods using the UCF Crime dataset. By analyzing the proposed fine-tuned 3DConvNets model, the study aims to assess its performance in accurately identifying various anomalous activities captured in surveillance videos. This involves comparing the proposed approach with existing state-of-the-art methods to determine its superiority in recognizing anomalous behaviors across different classes.

2. Dataset Selection and Analysis: Another key objective is to justify the selection of the UCF Crime dataset for the study. The case study delves into the characteristics of the dataset, including its size, composition, and the types of anomalies represented. It evaluates the suitability of the dataset for multiclass classification tasks and highlights any limitations or challenges associated with its use. Furthermore, the case study aims to provide insights into the preprocessing steps applied to the dataset to prepare it for model input, such as resizing video frames and extracting spatiotemporal features.

3. Methodology and Model Implementation: The case study focuses on elucidating the methodology employed in implementing the fine-tuned 3DConvNets model for anomalous activity recognition. It provides a detailed overview of the model architecture, including the layers and parameters involved. Additionally, the case study describes the training process, optimization techniques, and hyperparameters selected to enhance the model's performance. By elucidating the implementation details, the objective is to offer clarity on how the proposed approach operates and how it differs from existing methods.

4. Performance Evaluation and Comparative Analysis: Finally, the case study aims to evaluate the performance of the fine-tuned 3DConvNets model through rigorous experimentation and analysis. This involves assessing various statistical metrics, including accuracy, precision, recall, and F-measure, to gauge the model's efficacy in recognizing different classes of anomalous activities. Moreover, the case study conducts a comparative analysis with two state-of-the-art methods to benchmark the proposed approach's performance against existing techniques. By presenting comprehensive findings and insights, the objective is to determine the strengths and limitations of the proposed approach and its potential implications for real-world applications in surveillance and security.

Software Used:

1. Keras with TensorFlow Backend:

- Keras, a high-level neural networks API, served as the primary framework for building and training deep learning models.

- TensorFlow, as the backend for Keras, provided efficient computation and optimization capabilities for training convolutional neural networks (CNNs) and 3D convolutional networks (3DConvNets).

2. Python Programming Language:

- Python was the core programming language used for implementing the entire workflow, from data preprocessing to model evaluation.

- Its extensive ecosystem of libraries, including NumPy, Pandas, and Matplotlib, facilitated data manipulation, analysis, and visualization.

3. NumPy and Pandas:

- NumPy and Pandas were instrumental in handling multidimensional arrays (NumPy) and structured data (Pandas) efficiently.

- NumPy provided essential mathematical functions and operations for manipulating numerical data, while Pandas facilitated data loading, transformation, and exploration through its DataFrame data structure.

4. Matplotlib:

- Matplotlib, a comprehensive plotting library in Python, was used to create visualizations such as line plots, bar charts, and histograms.

- It enabled the visualization of model training/validation curves, performance metrics, and comparative analyses, aiding in the interpretation of results.

5. Scikit-learn:

- Scikit-learn, a versatile machine learning library, contributed to the evaluation of model performance through various metrics and tools.

- It provided functions for calculating accuracy, precision, recall, F-measure, confusion matrices, and receiver operating characteristic (ROC) curves, facilitating comprehensive performance analysis.

6. Jupyter Notebooks:

- Jupyter Notebooks offered an interactive computing environment conducive to exploratory data analysis, code experimentation, and result visualization.

- The integration of code, visualizations, and explanatory text within Jupyter Notebooks enhanced the reproducibility and interpretability of the study's findings.

Difficulty Faced:

During the implementation of the anomalous activity recognition methods discussed in the case study, several challenges and difficulties were encountered, which required careful consideration and resolution. Some of the key difficulties faced during the course of the study include:

1. Dataset Limitations:

- One of the primary challenges was the availability and suitability of datasets for training and evaluating the models. The researchers faced difficulties in finding a dataset that adequately represented real-world anomalies while also providing sufficient labeled data for supervised learning.

2. Data Preprocessing Complexity:

- Preprocessing the raw video data to extract meaningful features and annotations posed a significant challenge. The large volume of untrimmed videos, varying resolutions, and lack of precise anomaly segment annotations made the preprocessing pipeline complex and time-consuming.

3. Model Optimization and Tuning:

- Optimizing and fine-tuning the deep learning models, particularly the 3D convolutional networks (3DConvNets), required extensive experimentation and parameter tuning. Finding the optimal hyperparameters, architecture configurations, and training strategies to achieve high performance on the given dataset was a non-trivial task.

4. Computational Resource Constraints:

- The computational resources required for training and evaluating deep learning models, especially on large-scale video datasets, posed a practical limitation. Limited access to high-performance GPUs and memory constraints necessitated careful optimization of the model architectures and training procedures to achieve satisfactory results within resource constraints.

5. Interpretability and Generalization:

- Ensuring the interpretability and generalization of the models across different anomaly classes and real-world scenarios was another significant challenge. The researchers needed to carefully interpret the model predictions, analyze the failure cases, and identify potential sources of bias or overfitting to enhance the model's robustness and applicability.

Addressing these challenges required a combination of domain expertise, algorithmic innovation, and computational resources. Overcoming these difficulties not only facilitated the successful completion of the study but also contributed to the advancement of anomaly detection techniques in video surveillance and related domains.

Screen Shots:

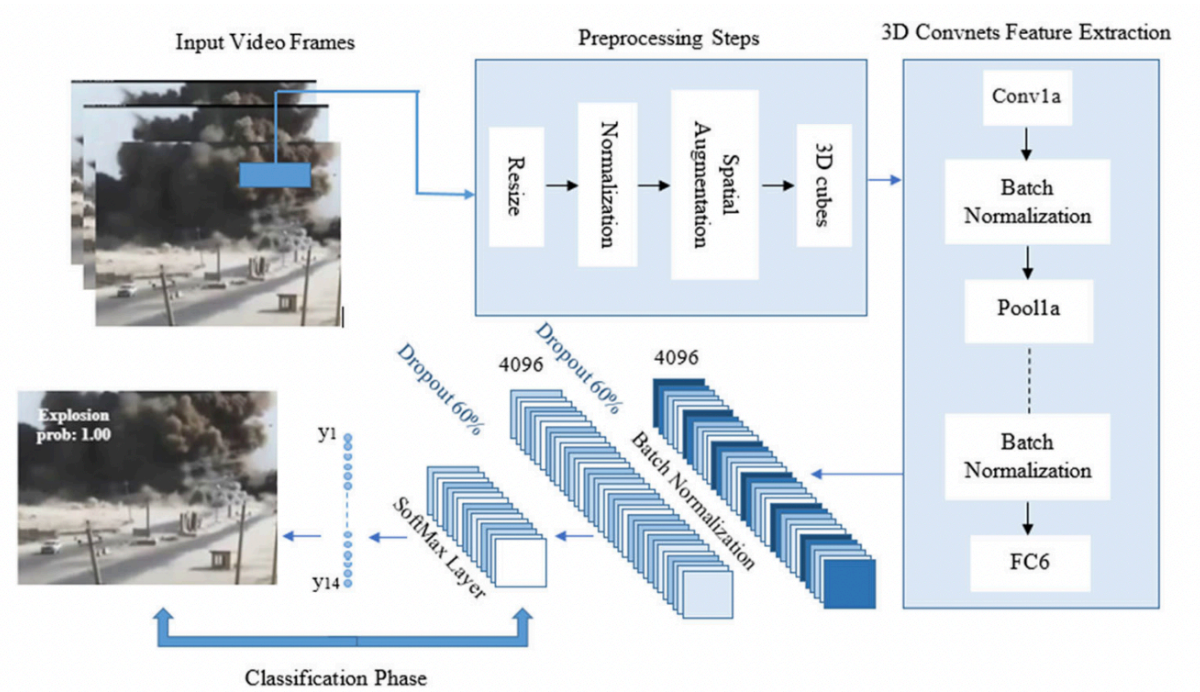
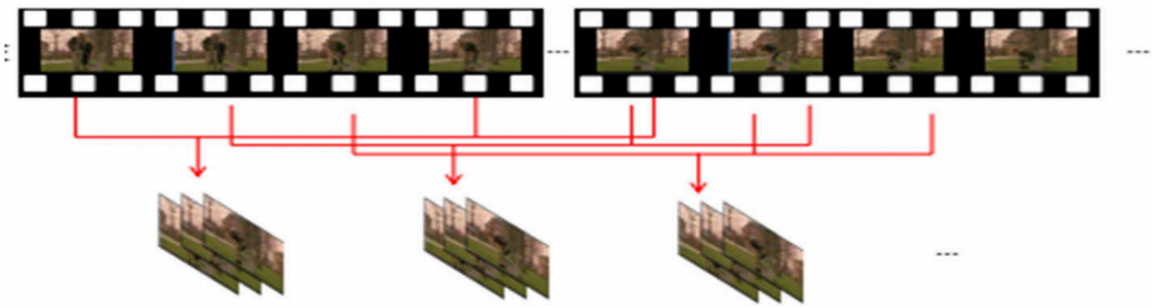
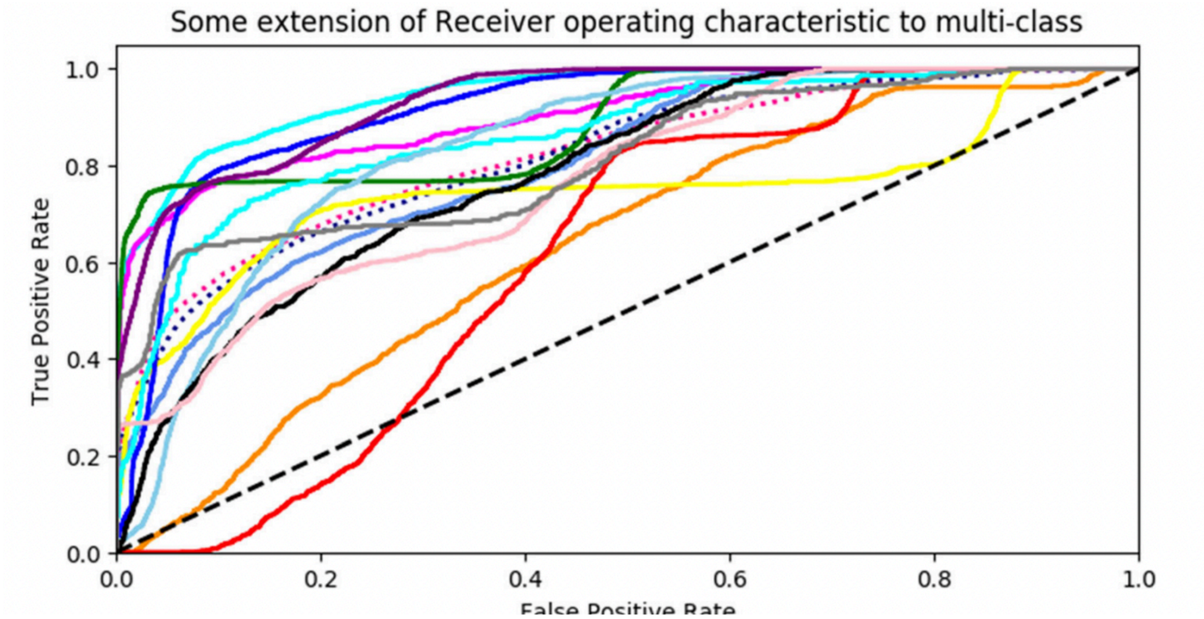


Fig. 3 Original UCF Crime dataset frames (Top) and vertical spatial augmented frames (Bottom)



Intermediate Frames from Real world Video				Prediction/ Frame No	Actual Class
				Normal/ Frame 04-68	Normal
				Road Accident/ Frame 395-413	Road Accident
				Explosion/ Frame 495/507	Explosion



Video Link (Make it Public):

https://drive.google.com/file/d/1RmIPOifLzbRKQLuAhXt1b0ZYcJ-b-q2v/view?usp=sharing

GitHub Link(Make it Public):

https://github.com/Shrimayee-Datta/Neurofuzzy-Journal-Paper