UNIVERSITÀ DEGLI STUDI DI SALERNO

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE ED ELETTRICA E MATEMATICA APPLICATA

EARLY FIRE DETECTION SYSTEM USING DEEP LEARNING

Team 39

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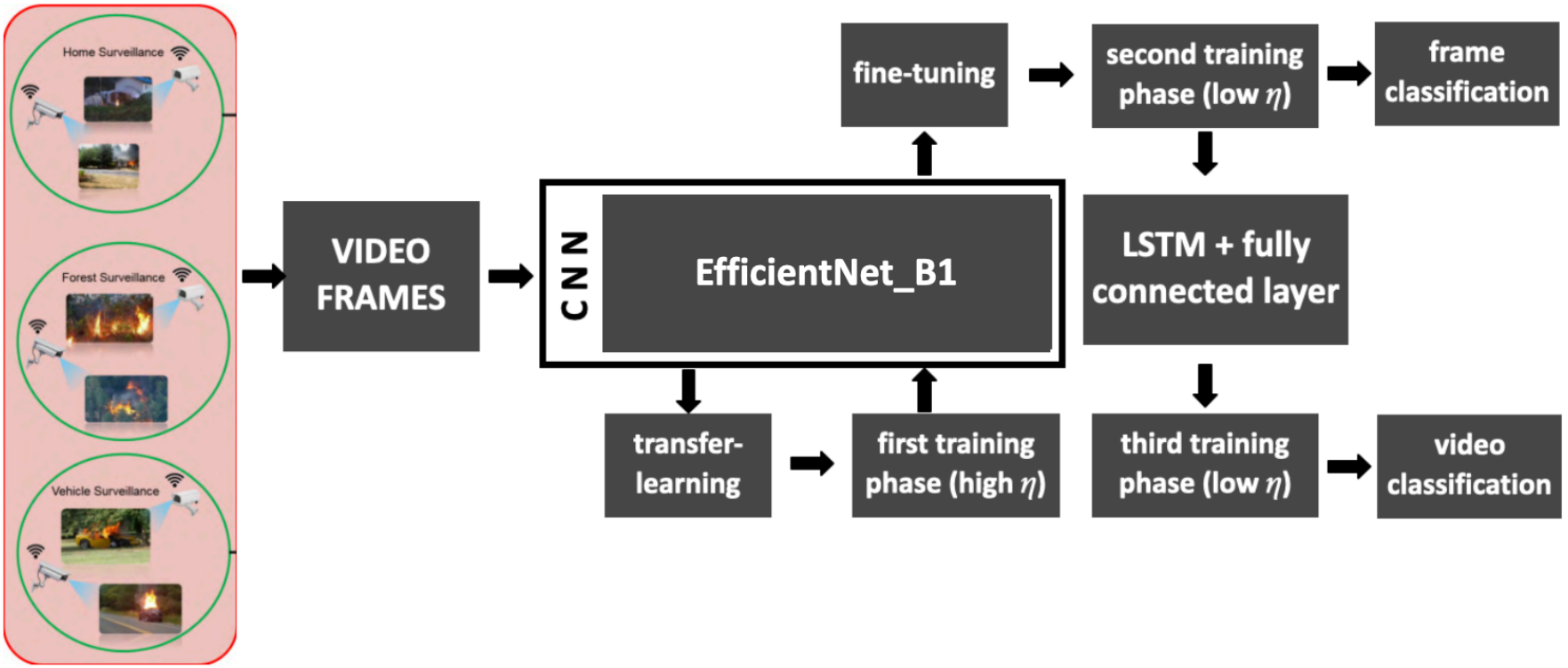
PROBLEM STATEMENT

- Computer vision-based fire detection is one of the crucial tasks in modern surveillance system.
- Fire is the most dangerous abnormal occurrence, because failure to control it at an early stage can lead to huge disasters, leading to human, ecological and economic losses.
- Real-time fire detection from image sequences is a highly requested feature in real video surveillance applications.
- Previously there is a lot of systems that detects fire or no fire but it will take more computational time and memory restricted implementation in surveillance networks.

OBJECTIVES

- Proposed a cost effective deep learning methods that take less computation resources to detect fire or no fire from sequence of videos.
- To find a good trade-off between fire detection accuracy, notification promptness.
- Compare our technique with state of the art techniques in terms of computation time, accuracy.
- Analyze the best hyperparmeters for our proposed technique.

METHOLODOGY OVERVIEW



DATASET

- Dataset consist of 312 videos divided into two classes:

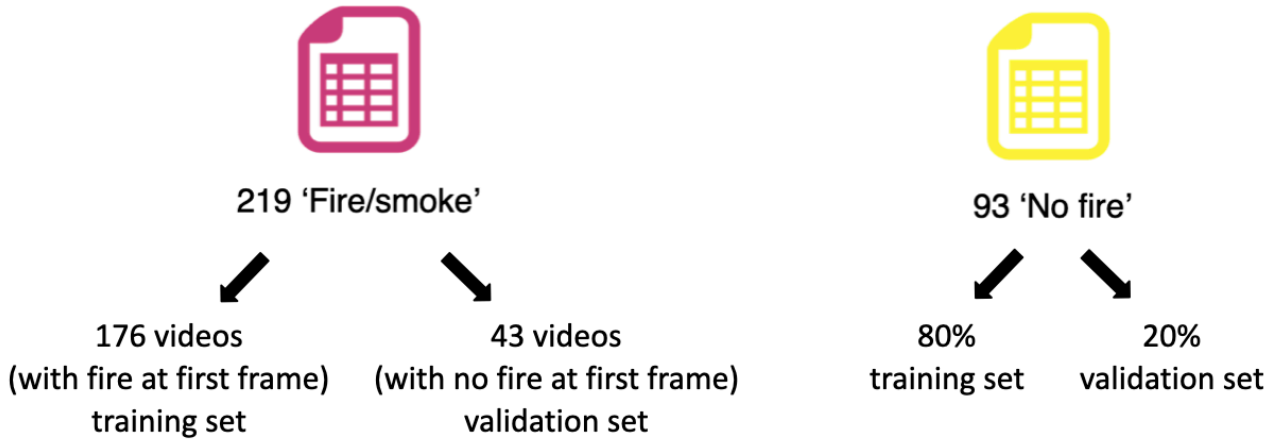
219 ‘Fire/smoke’

93 ‘No fire’

- More data is collected from different labs and kaggle but not used in training only used for testing purposes, checking the model performance.

DATA PREPROCESSING/Length pending

We divided training and validation datasets in this way:



Finally:

- Training set : 251 videos
- Validation set: 61 videos

DATA PREPROCESSING

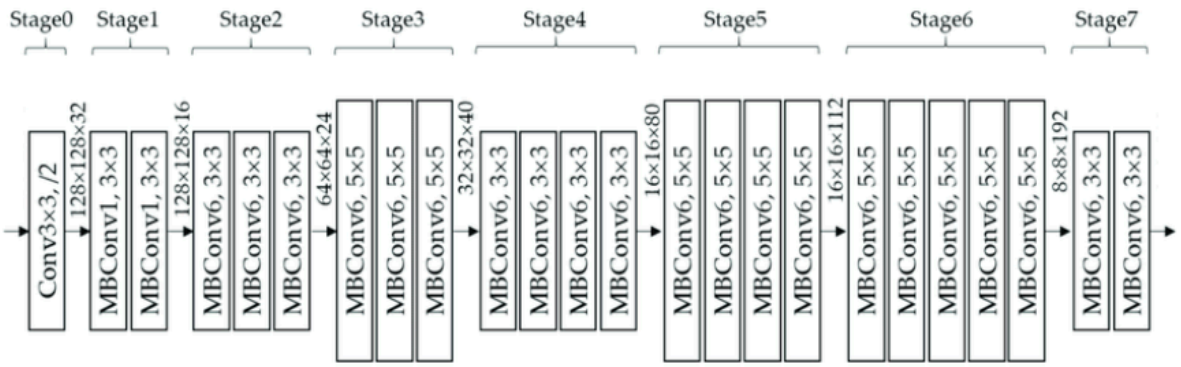
Used albumentation library for augmentation:

- Resize (resized with height = 224, width = 224)
- Normalize(img=(img-mean * max_pixel_value)/(std * max_pixel_value), 3D vector of means ([0.485, 0.456, 0.406]), 3D vector of standard deviations ([0.229, 0.224, 0.225]) and max_pixel_value = 225.0)
- HorizontalFlip(with a probability of 50%.)

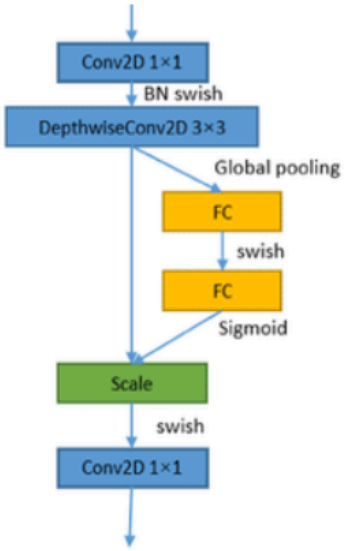
DATALOADER

- dataloader parameters, such as *batch_size=64*, *num_workers=2* and *pin_memory=True*
- shape of the dataloader objects was *[batch_size, num_frames, c, w, h]*
- To train the CNN model (shape of the dataloader *[64, 3, 256, 256]* since num_frames =1),
- We considered 5 consecutive frames for each video to create the dataloader used to train the LSTM model (shape of the dataloader *[64, 5, 3, 224, 224]*).

MODEL ARCHITECTURE



(a) Structure of EfficientNet_b1

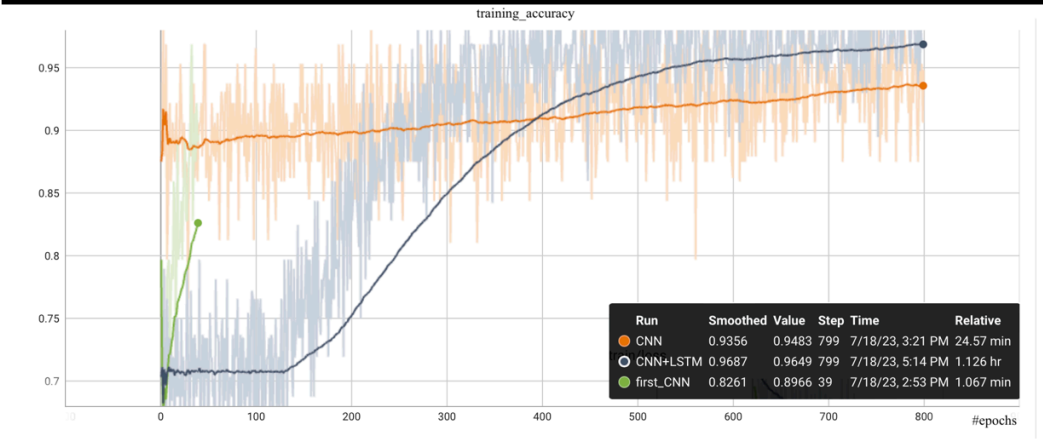


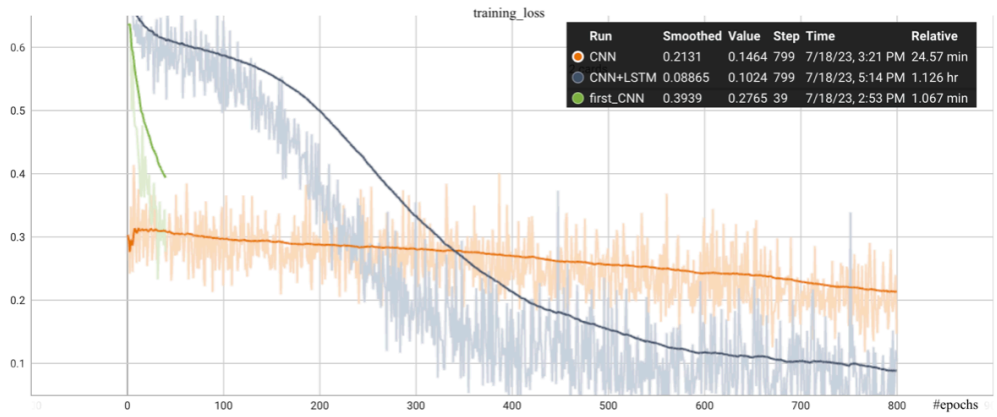
(b) MBConv module

MODEL PARAMETERS & HYPER-PARAMETETRS

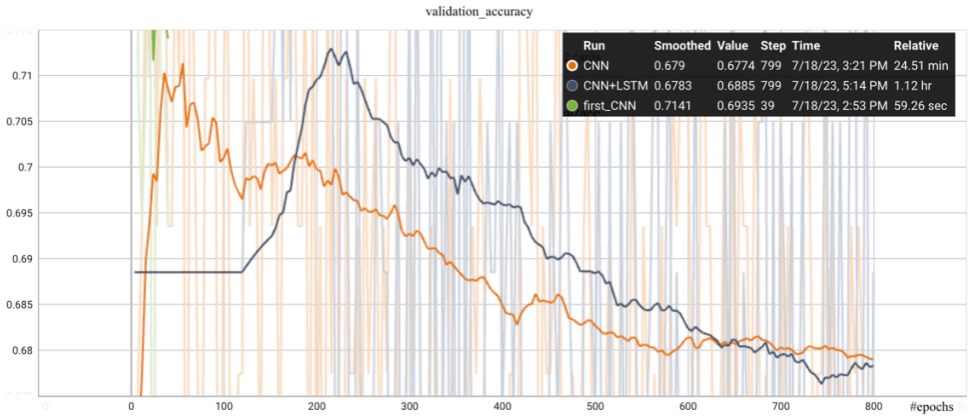
- Loss function: Binary cross entropy
- Momentum=0.9
- Learning Rate= 0.05 (first training phase), 0.0001 (second trading phase) and 0.001 (third training phase)
- Epoch's=10 (first training phase), 200 (second and third training phases)
- Early stopping_patience=5
- Activation function (Sigmoid)

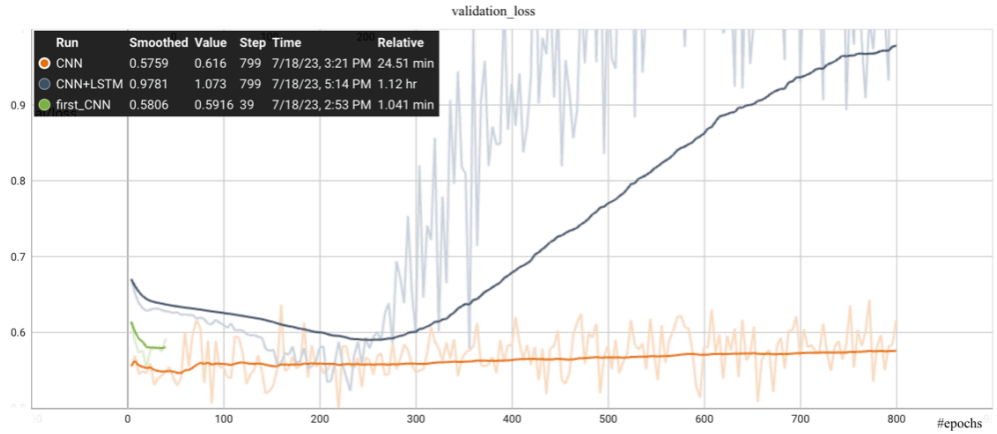
TRAINING ACCURACY VS TRAINING LOSS





VALIDATION ACCURACY VS VALIDATION LOSS





TESTING VIDEOS PERFROMNACE

```
!python test.py --videos foo_videos/ --results foo_results/
```

```
 Fire detected in Video2.mp4 at 2 sec
14

 Fire detected in Video0.mp4 at 0 sec
9

 Fire detected in Video1.mp4 at 1 sec
12
```

COMPARISON WITH TRADITIONAL METHODS

- Previously use GoogleNet, Alexnet and Resnet for fire detection and the main issue is the complexity of model, computational time, and delays of fire detection.
- Our proposed system (CNN with LSTM) consider spatial and temporal information for detection of fire or no fire in videos.
- We use Efficient Deep Neural Networks for collecting spatial feature(considering real time) this network behaves computationally expressive and provide better accuracy with state of the art.

CHALLENGES AND FUTURE WORK

- Firstly the main challenge is in dataset preprocessing because some videos have no fire in the start but this will be lie in fire videos.
- We use different CNN models (Resnet50, Resnet101),GoogleNet for feature collection and all of these EfficinetNet perform well (setting different hyper parameters) .
- Our model most of the time detect fire in car headlights, because the color of headlights is same as fire, so in future we handle these points.

CONCLUSION

- In this study we propose CNN with LSTM approach to consider spatial and temporal feature for fire detection
- Our proposed technique (using Efficient Net with best hyper parameter tuning) provide high reliability low False alarms.
- Considering the fair fire detection accuracy of the CNN with LSTM model, it can be of assistance to disaster management teams in managing fire disasters on time, thus preventing huge losses of life.

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THANKS FOR THE ATTENTION

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