Crowd Analysis Machine Learning

The project is dedicated to apply on CCTV and other survailance system for simple crowd monitoring and crowd analysis. The system is able to monitor for abnormal crowd activity, social distance violation and restricted entry. The other part of the system can then process crowd movement data into optical flow, heatmap and energy graph.

Abnormal crowd activity is monitored by computing crowd movement energy level.

Social distace violation is simply calculating distance between individuals. Two modes are given to calculate distance from edge of individuals or center of individuals from camera at different scenario.

Human detection is implemented using YOLOv4 via OpenCV built-in function. Tracking algorithm is implemented using Deep SORT, referencing the implementation by

Current functions implemented includes:

- Social distance rule violation
- Entries to restriced areas
- Abnormal crowd movement/activity
- Crowd movement tracks and flow
- Crowd stationaries point (Heatmap)

Building

YOLOv4-tiny is used for this documentation. You can use other YOLO variation for desire usage and output.

Files

Requirements

Install the requirements

```
pip install requirements.txt --user
```

Configuration

`config.py` contains all configurations for this program.
Place the **video source** under `VIDEO_CONFIG.VIDEO_CAP` in `config.py`
Refer to Manual on how to use the `config.py` file.

Running

Before you run the program, make sure you have input a valid **video source**. You have to provide your own video for the program. Replace the path at `VIDEO_CONFIG.VIDEO_CAP` in `config.py` with the path of your own video.
To process a video, run `main.py`

```
python3 main.py
```

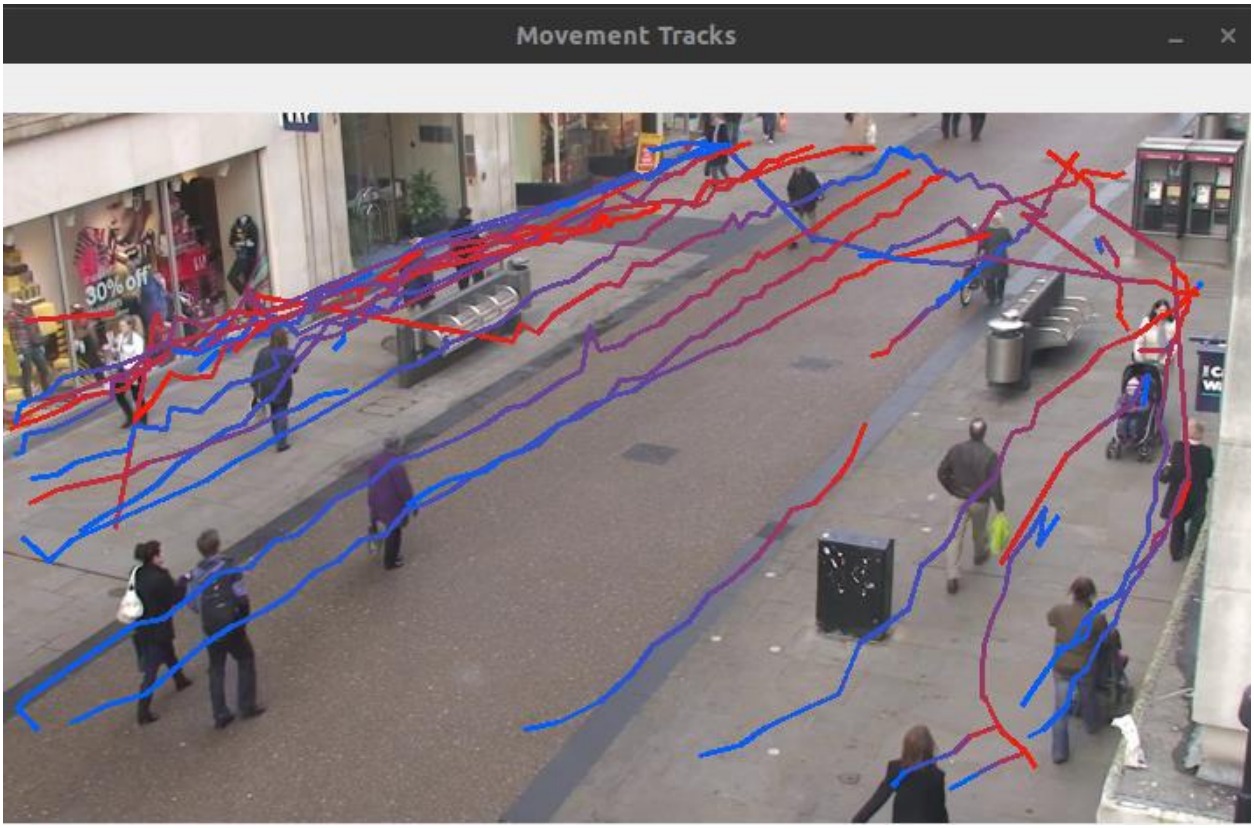
`main.py` will yield a set of data from the video source in the form of csv and json. These data will be placed in the directory `processed_data`.
From these data, you can generate movement data, crowd summary and abnormal crowd movement.

```
python3 abnormal_data_process.py
python3 crowd_data_present.py
python3 movement_data_present.py
```

`abnormal_data_process.py` will yield a summary for the processed energy data set and a graph of energy level over count. This process will clean outlier if the data set has a skewness larger than 7.5
`crowd_data_present.py` will yield a heatmap and optical flow. Optical flow shows the tracks of each individual. Heatmap shows the spot where individuals stop; the stronger the color, the longer or more individual stop at the given spot.
`movement_data_present.py` will yield a summary plot of crowd count, violation count, restricted entry detection and abnormal activity over time(frames).

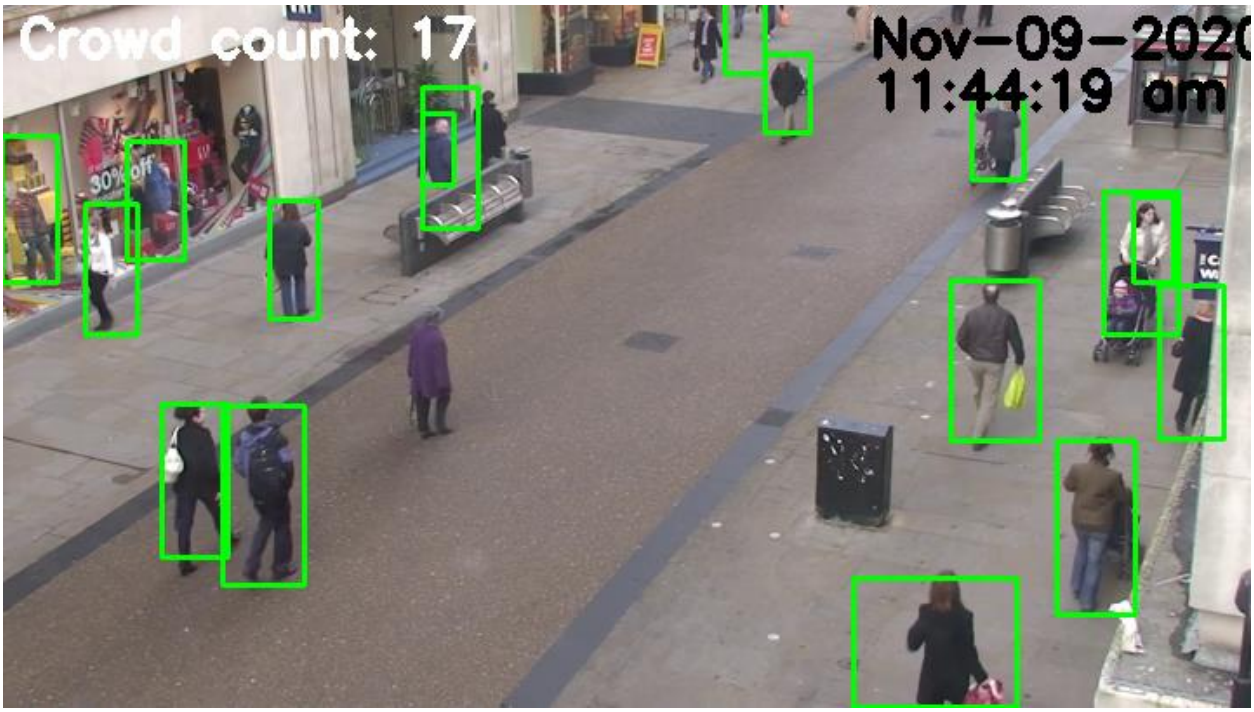
Sample Output

Optical flow of crowd movement



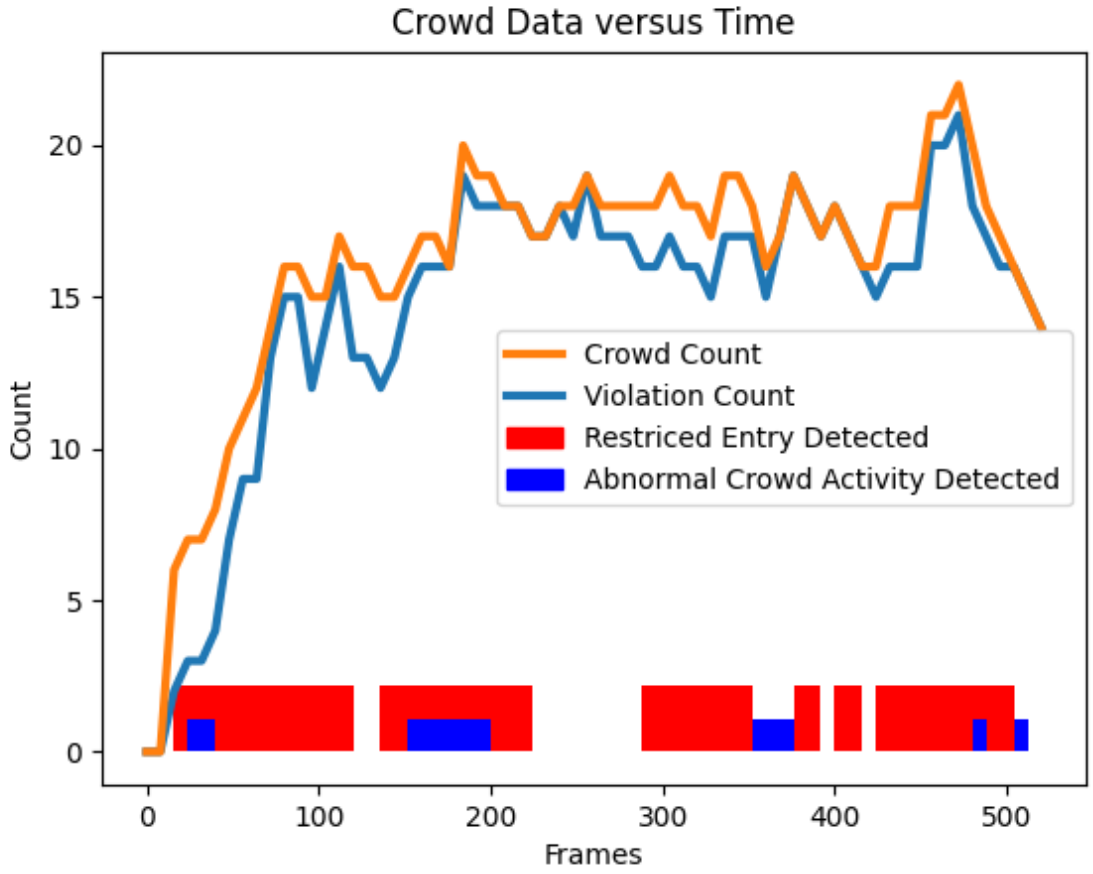
Stationary location Heatmap

Detection & Tracking

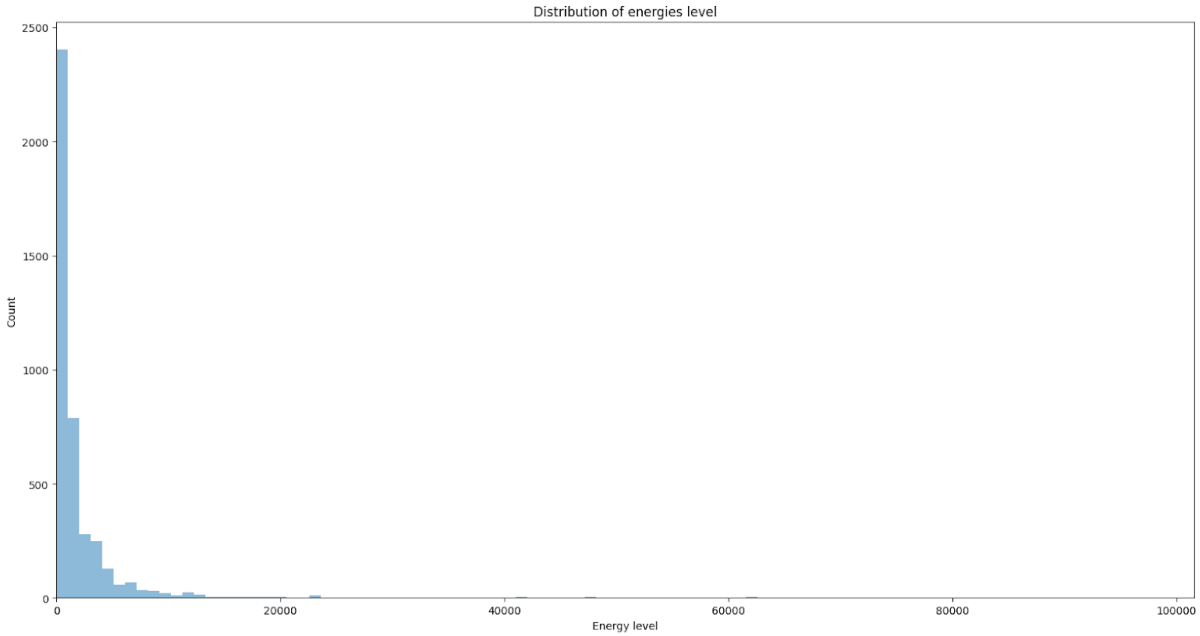


Social distance violation

Video summary



Energy level graph



User Manual

VIDEO_CONFIG

Configuration for video input.

Video configuration	Description
VIDEO_CAP	Video path. Put integer 0 for webcam
IS_CAM	Is the video input real-time. The value accept boolean
CAM_APPROX_FPS	If it is real time, input an approximate processing speed according. The value affects the data analysis, not video processing. The system can be run for 5 minutes to compute a rough processing speed.

Video configuration	Description
HIGH_CAM	Position of the camera. The value accepts boolean. This will affect the algorithm used to calculate distance for social distance checking.
START_TIME	Start time of the video process. In the format of (Y:M:D:H:M:S:ms)

YOLO_CONFIG

YOLO weight and cfg path. Warning! Do not touch without knowledge on OpenCV YOLO implementation.

YOLO Configuration	Description
WEIGHTS_PATH	YOLO weight path
CONFIG_PATH	YOLO config path

Other configuration

Configuration	Description
SHOW_PROCESSING_OUTPUT	To show the video output when processing. The value accepts boolean values. For true,the output will be shown. For false, the console will print a line “processing..” to let the user know the system is working.
SHOW_DETECT	To show individuals detected. The value accepts boolean values. For true, a green bounding box will be drawn over the detected person. For false, nothing will be done.

Configuration	Description
DATA_RECORD	To record data into files. The value accepts boolean values. For true, the data will be collected and recorded into file. For false, the data will not be collected, using lesser memory for the system.
DATA_RECORD_RATE	The rate of data recording, used only for pre-recorded video processing. The value accepts integer not more than video FPS. For example, value of 10 indicates 10 data will be recorded per frame
RE_CHECK	To check for restricted entry. The value accepts boolean values. For true, restricted entry will be checked. For false, nothing will be done.
RE_START_TIME	Restricted entry timer start time. In the format of (H:M:S)
RE_END_TIME	Restricted entry timer start time. In the format of (H:M:S)
SD_CHECK	To check for social distance violations. The value accepts boolean values. For true, social distance will be checked. For false, nothing will be done.
SHOW_VIOLATION_COUNT	To display social distance violation count. The value accepts boolean values. For true, social distance count will be displayed. For false, nothing will be done.
SHOW_TRACKING_ID	To display the tracking id of the detected object. The value accepts boolean values. For true, tracking id of the detected object will be displayed. For false, nothing will be done.
SOCIAL_DISTANCE	Minimum distance for social distance, in terms of pixels. The value accepts integer value. The default value is 50.
ABNORMAL_CHECK	To check for abnormal crowd activity. The value accepts boolean values. For true, abnormal crowd

Configuration	Description
	activity will be checked. For false, nothing will be done.
ABNORMAL_MIN_PEOPLE	The minimum number of people to exist in the frame before abnormal activity will be checked. The value accepts integers. The default value is 5.
ABNORMAL_ENERGY	Threshold for energy to be classified as abnormal energy. The value accepts integers. The value should be computed with abnormal_data_process.py when data is extracted from a video.
ABNORMAL_THRESH	Threshold for the ratio of abnormal energy count over the total detected person to trigger abnormal activity warning. The value accepts float and should be between 0 to 1. The default value is 0.66.
MIN_CONF	Threshold for YOLO human detection minimum confidence. The value accepts float and should be between 0 to 1. The default value is 0.3. Warning, best not to change the value without prior knowledge on YOLO
NMS_THRESH	Threshold for Non-maxima suppression on detected objects from YOLO. The value accepts float and should be between 0 to 1. The default value is 0.2. Warning, best not to change the value without prior knowledge on YOLO and NMS
FRAME_SIZE	Frame size to be resized and used in video processing. The value accepts integers and should be between 480 to 1920. The default value is 720.
TRACK_MAX_AGE	Tracker max missing age before removing in terms of seconds. The value accepts integers. The default value is 3. Warning! Do not change the value without prior knowledge on Deep SORT and object detection on video.