Project 16

UAV Ground Scanning System

Human detection with deep learning

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Contents

Introduction

Problem statement

- People find more practical uses for UAV ground scanning system
- Several drawbacks for consumer's surveillance cameras.
- Lack of night vision (i.e. infrared imaging), and mobility

Problem statement

- Felonies occurred more during night time than daytime(TheSleepJudge)

- Tracking people by the UAV during the night can help increase the rate of the solved criminal cases

https://www.thesleepjudge.com/crimes-that-happen-while-you-sleep/
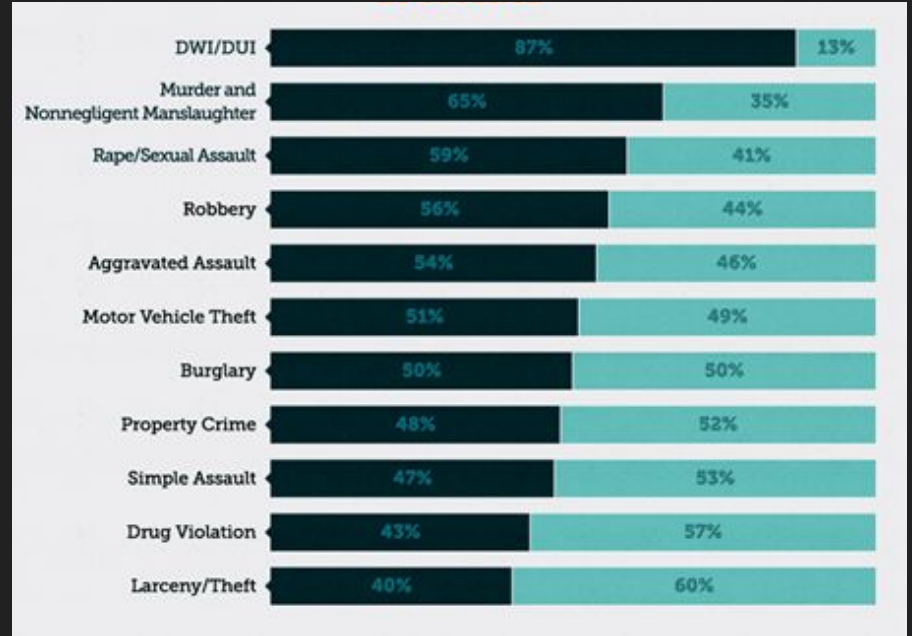
Project goal

"Build a system one UAV that will use infrared camera to detect humans on the ground and track them using GPS location"

Main use:
1. security
2. potential anti-terrorism app

Project goal

- Raspberry pi, GPS sensor, and infrared imaging camera
- Once the camera detects the shape of a human being, it will take an infrared image of the person and utilize the GPS sensor to provide the exact location of the culprit.
- This paper presents a deep learning-based convolutional neural network (CNN) for images taken from a high-altitude downward angle
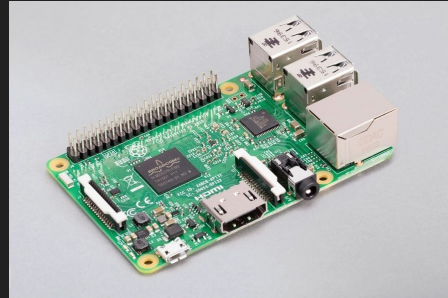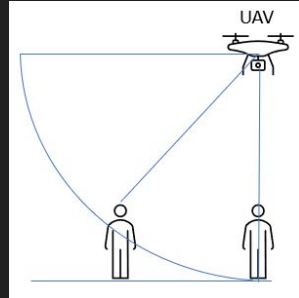
Abstract

- the infrared dataset made by the research team is introduced
- Both YOLO and SSD algorithms are utilized in this research
- YOLOv3 and SSD mobile net are used in the phase of transfer learning.
- The system is expected to be deployed and push warning messages with GPS information when human are detected when searching or rescuing events are operated.

Body

Dataset

- Data collecting

  Due to the UAV policy of Seoul, the dataset were collected by photographs from rooftops or high stories of buildings
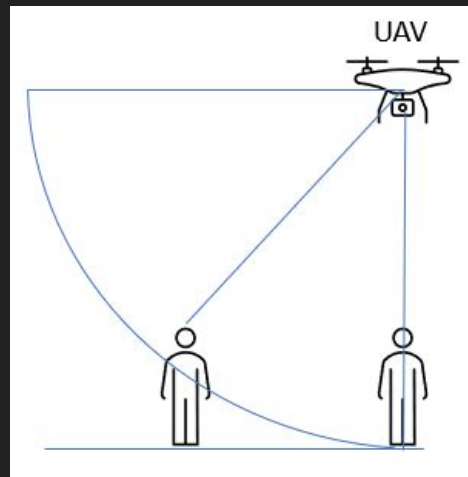
Dataset

- Image preprocessing

  Labeled images with Labeling tool, and got data of xml files of bounding boxes
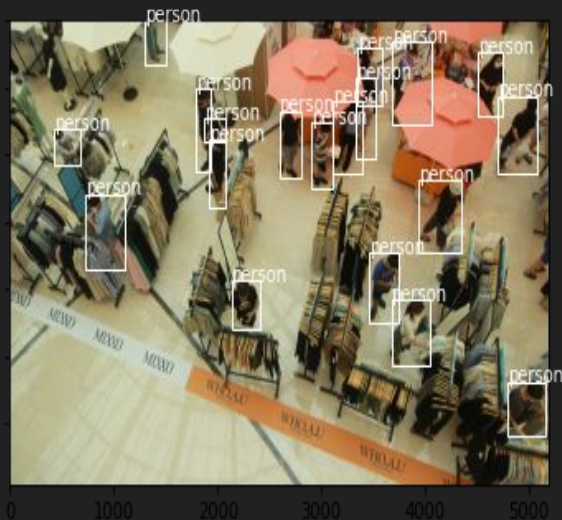
```xml
<annotation>
        <folder>dataset</folder>
        <filename>057.JPG</filename>
        <path>/Users/gwak2837/Python/UAV/Model/dataset/057.JPG</path>
        <source>
                <database>Unknown</database>
        </source>
        <size>
                <width>5184</width>
                <height>3456</height>
                <depth>3</depth>
        </size>
        <segmented>0</segmented>
        <object>
                <name>person</name>
                <pose>Unspecified</pose>
                <truncated>0</truncated>
                <difficult>0</difficult>
                <bndbox>
                        <xmin>2132</xmin>
                        <ymin>1940</ymin>
                        <xmax>2402</xmax>
                        <ymax>2300</ymax>
                </bndbox>
        </object>
        <object>
```

filename	width	height	class	xmin	ymin	xmax	ymax
032.JPG	5184	3456	person	151	395	566	975
032.JPG	5184	3456	person	2117	1	2322	475
032.JPG	5184	3456	person	4462	185	4892	765
033.JPG	5184	3456	person	2137	1	2352	440
033.JPG	5184	3456	person	4472	160	4897	730
033.JPG	5184	3456	person	2792	2830	3192	3350
033.JPG	5184	3456	person	3117	2530	3467	3075
034.JPG	5184	3456	person	2342	1655	2617	2215
034.JPG	5184	3456	person	2042	1975	2467	2545
034.JPG	5184	3456	person	2157	1	2337	375
034.JPG	5184	3456	person	4517	105	4957	675
035.JPG	5184	3456	person	1927	1325	2142	1765

Machine learning

- Dataset annotation: YOLO & VOC

- Utilizing pre-trained model:

    - detection / customized code with GPS info with YOLOv3 tf1

    - detection with SSD using TensorFlow Lite

- Training Phase - Loss
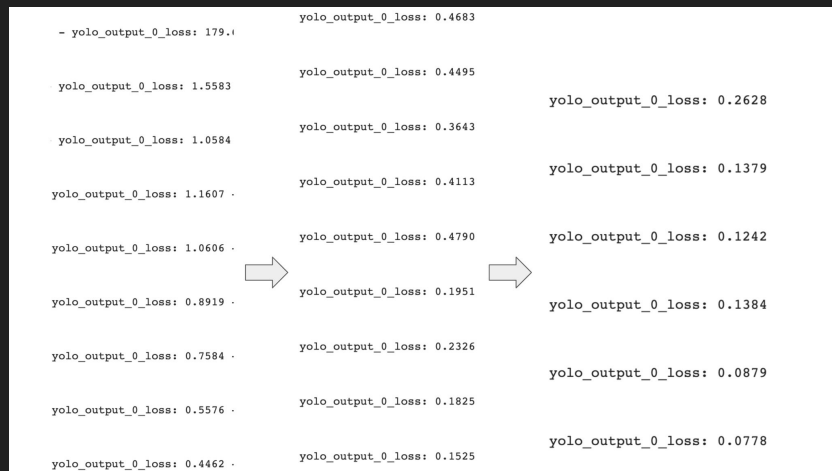
Sensors

- Images will be tagged with the exact GPS location the picture was taken.
- The image will then be sent to the host computer and stored for further review.

Demo

train_test.ipynb

파일 수정 보기 삽입 런타임 도구 도움말

+ 코드   + 텍스트

```
WARNING:tensorflow:A checkpoint was restored (e.g. tf.train.Checkpoint.restore or tf.keras.Model.load_weights) but not all checkpointed values were used. See above for specific issues. Use expect_partial() on the load status object, e.g. tf.train.Checkpo
W0819 18:39:20.555323 140012095759680 util.py:170] A checkpoint was restored (e.g. tf.train.Checkpoint.restore or tf.keras.Model.load_weights) but not all checkpointed values were used. See above for specific issues. Use expect_partial() on the load stat
2021-08-19 18:39:20.368348: I tensorflow/core/profiler/lib/profiler_session.cc:126] Profiler session initializing.
2021-08-19 18:39:20.368476: I tensorflow/core/profiler/lib/profiler_session.cc:141] Profiler session started.
2021-08-19 18:39:20.368811: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcupti.so.11.2'; dlerror: libcupti.so.11.2 cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /usr/lib
2021-08-19 18:39:20.409908: I tensorflow/stream_executor/platform/default/dso_loader.cc:53] Successfully opened dynamic library libcupti.so
2021-08-19 18:39:20.414334: I tensorflow/core/profiler/lib/profiler_session.cc:159] Profiler session tear down.
2021-08-19 18:39:20.414455: I tensorflow/core/profiler/internal/gpu/cupti_tracer.cc:1743] CUPTI activity buffer flushed
/usr/local/lib/python3.7/dist-packages/tensorflow/python/keras/utils/generic_utils.py:497: CustomMaskWarning: Custom mask layers require a config and must override get_config. When loading, the custom mask layer must be passed to the custom_objects argume
  category=CustomMaskWarning)
2021-08-19 18:39:20.987174: I tensorflow/compiler/mlir/mlir_graph_optimization_pass.cc:176] None of the MLIR Optimization Passes are enabled (registered 2)
2021-08-19 18:39:20.990267: I tensorflow/core/platform/profile_utils/cpu_utils.cc:114] CPU Frequency: 2199995000 Hz
Epoch 1/100
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow/python/util/deprecation.py:602: calling map_fn_v2 (from tensorflow.python.ops.map_fn) with dtype is deprecated and will be removed in a future version.
Instructions for updating:
Use fn_output_signature instead
W0819 18:39:23.563963 140012095759680 deprecation.py:534] From /usr/local/lib/python3.7/dist-packages/tensorflow/python/util/deprecation.py:602: calling map_fn_v2 (from tensorflow.python.ops.map_fn) with dtype is deprecated and will be removed in a futur
Instructions for updating:
Use fn_output_signature instead
      1/Unknown - 22s 22s/step - loss: 4089.4944 - yolo_output_0_loss: 155.0009 - yolo_output_1_loss: 997.9848 - yolo_output_2_loss: 2925.9358 2021-08-19 18:39:44.015398: I tensorflow/core/profiler/lib/profiler_session.cc:126] Profiler session initializin
2021-08-19 18:39:44.015450: I tensorflow/core/profiler/lib/profiler_session.cc:141] Profiler session started.
      2/Unknown - 31s 10s/step - loss: 4400.0630 - yolo_output_0_loss: 264.3000 - yolo_output_1_loss: 1026.0297 - yolo_output_2_loss: 3100.6543 2021-08-19 18:39:53.238531: I tensorflow/core/profiler/lib/profiler_session.cc:66] Profiler session collecting
2021-08-19 18:39:53.338828: I tensorflow/core/profiler/internal/gpu/cupti_tracer.cc:1743] CUPTI activity buffer flushed
2021-08-19 18:39:53.347706: I tensorflow/core/profiler/internal/gpu/cupti_collector.cc:673]  GpuTracer has collected 0 callback api events and 0 activity events.
2021-08-19 18:39:53.361404: I tensorflow/core/profiler/lib/profiler_session.cc:159] Profiler session tear down.
2021-08-19 18:39:53.394942: I tensorflow/core/profiler/rpc/client/save_profile.cc:137] Creating directory: logs/train/plugins/profile/2021_08_19_18_39_53
2021-08-19 18:39:53.415572: I tensorflow/core/profiler/rpc/client/save_profile.cc:143] Dumped gzipped tool data for trace.json.gz to logs/train/plugins/profile/2021_08_19_18_39_53/1a844637fcf0.trace.json.gz
2021-08-19 18:39:53.432428: I tensorflow/core/profiler/rpc/client/save_profile.cc:137] Creating directory: logs/train/plugins/profile/2021_08_19_18_39_53
2021-08-19 18:39:53.432550: I tensorflow/core/profiler/rpc/client/save_profile.cc:143] Dumped gzipped tool data for memory_profile.json.gz to logs/train/plugins/profile/2021_08_19_18_39_53/1a844637fcf0.memory_profile.json.gz
2021-08-19 18:39:53.433682: I tensorflow/core/profiler/rpc/client/capture_profile.cc:251] Creating directory: logs/train/plugins/profile/2021_08_19_18_39_53 Dumped tool data for xplane.pb to logs/train/plugins/profile/2021_08_19_18_39_53/1a844637fcf0.xpla
Dumped tool data for overview_page.pb to logs/train/plugins/profile/2021_08_19_18_39_53/1a844637fcf0.overview_page.pb
Dumped tool data for input_pipeline.pb to logs/train/plugins/profile/2021_08_19_18_39_53/1a844637fcf0.input_pipeline.pb
Dumped tool data for tensorflow_stats.pb to logs/train/plugins/profile/2021_08_19_18_39_53/1a844637fcf0.tensorflow_stats.pb
Dumped tool data for kernel_stats.pb to logs/train/plugins/profile/2021_08_19_18_39_53/1a844637fcf0.kernel_stats.pb

      7/Unknown - 77s 9s/step - loss: 3674.1482 - yolo_output_0_loss: 252.8866 - yolo_output_1_loss: 964.9246 - yolo_output_2_loss: 2445.7588
```
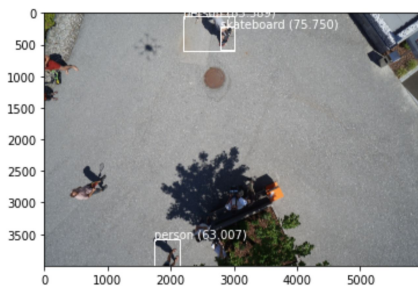
```
import sys
from absl import app, logging, flags
from absl.flags import FLAGS
import time
```

10820 01:58:58.160714 140093502216064 <ipython-input-45-e152923b5823>:67] classes loaded
10820 01:58:59.068197 140093502216064 <ipython-input-45-e152923b5823>:78] time: 0.8976318836212158
10820 01:58:59.069945 140093502216064 <ipython-input-45-e152923b5823>:80] detections:
10820 01:58:59.074078 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.6358130574226379, [0.6059631   0.56887245 0.72638357 0.73390746]
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10820 01:58:59.091630 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5353112816810608, [0.66796666 0.95120853 0.7004078   0.9813264]
10820 01:58:59.096397 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5289900898933411, [0.70611405 0.7306176   1.0182242   0.9567066]
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10820 01:58:59.109625 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5144052505493164, [0.5827894   0.67153317 0.78520036 0.8250045]
10820 01:58:59.122722 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5119386315345764, [0.42324916 0.9548382   0.44610497 0.97776526]
10820 01:58:59.129213 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5116311311721802, [-0.01126583 0.57432216 0.309251   0.72918123]
10820 01:58:59.134895 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5078510642051697, [0.73388326 0.59699434 0.81448615 0.6955196]
10820 01:58:59.139962 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5052423477172852, [0.44711685 0.94959575 0.47103894 0.9820923]
10820 01:58:59.146518 140093502216064 <ipython-input-45-e152923b5823>:84]   person, 0.5050229430198669, [0.9612527 -0.0225471   1.0097902   0.0423802]

```
I0820 02:01:11.903848 140093502216064 <ipython-input-49-8b8ce6ce8b55>:67] classes loaded
I0820 02:01:12.815246 140093502216064 <ipython-input-49-8b8ce6ce8b55>:78] time: 0.9004161357879639
I0820 02:01:12.816781 140093502216064 <ipython-input-49-8b8ce6ce8b55>:80] detections:
I0820 02:01:12.821062 140093502216064 <ipython-input-49-8b8ce6ce8b55>:84]         person, 0.541739821434021, [0.16458425 0.82107353 0.97162235 0.90234315]
```
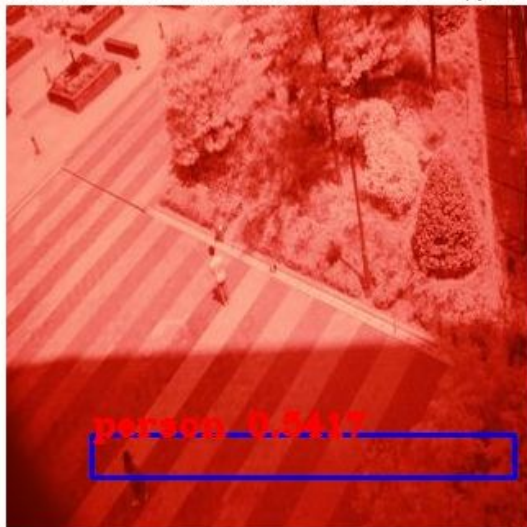
Conclusion

Conclusion

- Novel human sensing method based on deep CNN.

  - combine deep learning model and IoT devices
  - tracks objects at dark conditions => infrared rays

- Dataset

  - both day and night infrared image set were generated in high downward angles
  - ADH dataset was used in training weights of YOLO v3 and SSD mobile networks

Future plans

- Additional training on own datasets

- The model should converted to a version of TensorFlow Lite that is compatible with Raspberry Pi's 32-bit operating system.

- Demo video with actual UAVs in live will be recorded after distribution.

QnA

THANK YOU