**Smart Surveillance with Python**

Kranthi Putta

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Research Paper

Harrisburg University

1. **Problem Statement:**

Machine learning models & AI are popular term in past couple of years. Almost every aspect on our daily life we are using these machine learning models & AI knowing or unknowing. The simple statement of this research paper is to prove reduction of human effort in camera surveillance by using machine learning models such as objection detection & facial recognition.

TensorFlow is leading open source tool developed and published by Google helps to build objection detection and facial recognition library. The code we about to develop can allow user to train model with his choice of images of objects and faces of persons. The user developed model must detect, track and alert user. The code written in python and OpenCV, Twilio, TensorFlow technology used makes python code works. So, this python code helps user without his presence in securing user premises.

1. **Technologies:**
2. **TensorFlow**

In machine learning TensorFlow is most popular and commonly used platform. It’s open source end-end communication platform published by google. This platform written in python, CUDA, C++.

The toolkits in TensorFlow allotted by level as shows low level TF API which is extensive control, when TF code can run multiple platform called GPU, CPU and TPU, to use common model for reusable libraries tf.layers, tf.metrics and last high-level object oriented API is tf.keras and estimators.

It’s builds models based on data flow. It allows developer to create CNN or large-scale neural network with combination of many layers. It’s mainly used for Arrangement, Perception, Understanding, Discovering, Prediction and Creation.

1. **Object Detection**

Object detection is technique related to computer vision to detect the objects class such as car, animal, person etc. Object detection, object localization, image classification are three computer vision tools to make object detection concept works.

Picture arrangement includes allotting a class name to a picture, while object limitation includes drawing a bouncing box around at least one items in a picture. Article location is more testing and consolidates these two errands and draws a jumping box around each object of enthusiasm for the picture and appoints them a class mark. Together, these issues are alluded to as item acknowledgment.

To prepare a custom model, you need named information. Named information with regards to object detection are pictures with relating jumping box organizes and names. That is, the base left and upper right (x,y) + the class .

1. **Face recognition**

Face recognition Facial recognition is a biometric system that estimates extraordinary attributes about one's face. It used to identify the faces of persons from image or video. Deep learning algorithms helps to detect faces by using neural networks.

The appearance-based strategy shows a face with respect to a few pictures. A picture considered as a high dimensional vector. This system is generally used to get an element space from the picture division. The example picture contrasted with the preparation set. Then again, the model-based methodology attempts to show a face. The new example executed to the model and the parameters of the model used to perceive the picture.

The labeling in facial recognition is simple compare to object detection there are some scripts developed for this the user just must place faces of persons in given folder and theses scripts take care of rest.

1. **Machine Learning Models**

The machine learning models helps to predict the outcome of given input. These models divided into supervised or unsupervised. If the model is successful called supervised divided into either regression or classification.

When output of model is continuous called regression such as linear regression, neural networks so on. The neural network is multilayer model is inspired by human brain. When the output is discrete called classification such as logistic regression.

The machine learning models

That are using in object detection & facial recognition are kNN.

1. **TWILIO**

Twilio is web-based SMS service

Which send alert to user mobile. By this the final working code send alert to user about detected faces of persons or objects.

1. **Related Works:**

There are several related works which demonstrate detecting objects and faces of persons using TensorFlow as platform.

There are pre-trained models for object detection and face recognition. so, it’s easy for user to run these programs to detect, identify objects or persons in images or videos. RCNN, Fast RCNN, YOLO, CNN, Fast CNN are some of pre-trained models.

We can see there are a lot tutorial in object detection and facial recognition. But combination of object detection & facial recognition there are none to public access. We are working on this topic to combine of this powerful vision tools in computer world to build perfect surveillance system.

There is one tutorial in GitHub about utilizing SMS services with object detection to get alert to user when object pass threw his webcam. Still the user has known technical & programming stuff to use advantages provided by OB & FR. May be in coming year the user can run and train his own model without knowledge of programming which is possible while turning this library & coding interface into GUI interface.

The machine learning models like RCNN, CNN, Fast CNN, SSD model. Each model has its own importance such one model is good at detection at images one at good at video and the user has to select depends on his requirements.

1. **Implementations:**

The implementation of this concept must follow multiple steps and install requirements library & software.

As we discussed in problem statement about concept of this project to reduce human effort in surveilling live video. First user must install and verify TensorFlow platform and python software in his system. After installing user has to setup object detection and face recognition library with TensorFlow.

After finishing requirements next step is to create a database. The dataset must be in format of images of user selection. For example, if user choose car dataset must be contains cars in each image.

After selection of images of object and faces of persons it’s time for creating labelling to separate user want object from different object in each image. For object detection the user must create label for every image to train model. For facial recognition the user must assign each person face to one folder don’t keep different faces in one folder.

After labelling next step is to train model using labeled data set. There is a train.py python code in object detection and face recognition library click on this to train model. Training takes time to complete in mean while the user can setup Twilio account details to system variable.

After training we can run the final code to test the concept. The user needs webcam or external camera to capture live feed. The objects or the faces of persons pass through live feed the code matches them with images in trained model is it not matched it shows nothing for objects unknown for person faces. Incase it comes out as positive it shows object name or person name and the code sends text to user the object or person name to user phone via provided Twilio account. Therefore, concept is proved human presence don’t need to observe live feed threw camera.

1. **Results:**

The program worked as expected. It tested both on function and non-function requirements written user stories and discussed detailed code implementation in separate report.

1. **Conclusion & Future Improvements:**

After I decided to work on this topic it’s difficult because I didn’t find almost any material on this concept. I did find object detection and face recognition tutorials, but I didn’t find them as together so, it very changeling for me to write code that uses both library at once. During development I did learn lot about machine learning models how to choose as per requirement.

I have some difficulties during development especially the code must read detected object or person name to send SMS to user via Twilio.

My future work about this is convert to GUI interface so user can use this product by clicking some buttons.

1. **References:**

TensorFlow, Retrieved at: https://www.tensorflow.org/install

Twilio. Retrieved at https://www.twilio.com/sms

Retrieve Nvidia Tool Kit Retrieved from

https://developer.nvidia.com/cuda.

Retrieve Protocol Buffers <https://github.com/protocolbuffers/protobuf/releases>

Live Object Detection

<https://towardsdatascience.com/live-object-detection-26cd50cceffd>.

How to train your own Object

Detector with TensorFlow’s

Object Detection API:

<https://medium.com/towards-data-science/how-to-train-yourown-object-detector-with-TensorFlows-object-detector-api-bec72ecfe1d9>