Image Based Drone Stabilization

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Why This Problem?

- Drones as we know are very unstable and with all those controls it becomes very hard to stabilize them and make them stay at one place.
- This is a big problem for indoor surveillance companies, who want to check the condition of buildings with the help of drones which actually doesn't require the experts always to be present at the site.
- If the drones are stable and can be at same place for longer time it makes the surveillance of buildings very easy and convenient for experts.

Background

1. Business/Customers

Now a days we see an increase in the use of drones in various areas so potential market for this problem of drone stabilization is very big. Also many big companies like DJI and parrot are currently trying to solve this problem and are partially successful. So getting a working algorithm for image based drone stabilization can create a good market as well.

2. Academic Literature

- Digital Video stabilization involves three stages: motion estimation, motion smoothing, and image composition.
- In this research paper they come up with some motion estimation and exact matching algorithm to solve this problem through computer vision instead of using mechanical techniques which are not that good. For this they used AR Drone which has USB drone flash storage and 1 GHz ARM Cortex processor running a minimalistic GNU/Linux system.(https://www.aaai.org/ocs/index.php/FLAIRS/FLAIRS15/paper/download/10398/10299)

3. Industry Solutions.

1. DJI is extensively working on image stabilization and also Drone stabilization. In drone DJI Inspire 1, DJI worked on this problem and were successful to stabilize the drone as they were able to fly it indoors.
2. Parrot also were working on the same problem in the drone parrot bebop where they successfully stabilized the drone on 3 axes.
3. The Skydio 2 feed's data into the Nvidia Tegra X2 processor that runs the drone's AI scene-processing software. By understanding its full surroundings, the drone can plot a course around buildings and through forest trees as it tracks its designated subject.

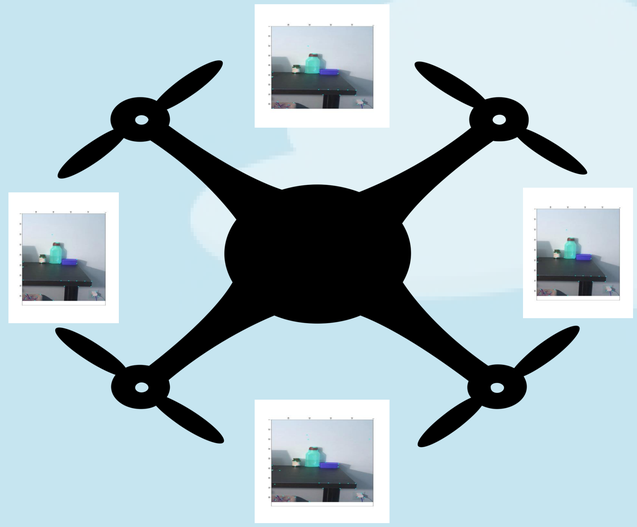
References & Info

- **Github Repository**: https://github.com/RohanBhosale4229/Image-Based-Drone-Stabilization-
- https://ti.arc.nasa.gov/m/tech/rse/publications/papers/AIKFA04/autofilter.pdf
- https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_feature2d/py_fast/py_fast.html#fast
- http://www.mva-org.jp/Proceedings/2011CD/papers/09-27.pdf
- https://github.com/rlabbe/Kalman-and-Bayesian-Filters-in-Python

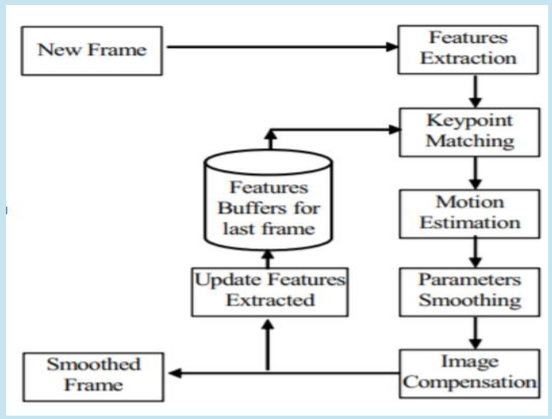
Thank You.(Remaining)

Dataset

- We have trained our model on a video which was made by our phones.
- Here we will be predicting the drift of the drone, which means we will be predicting 6 axis value. So, we can stabilize the drone by giving reverse command.
- We will also be using this video for object detection which helps the drone to lock the vision on a particular object and will also help in stabilization.

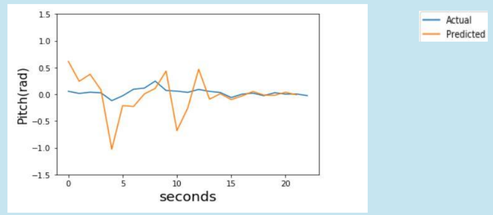


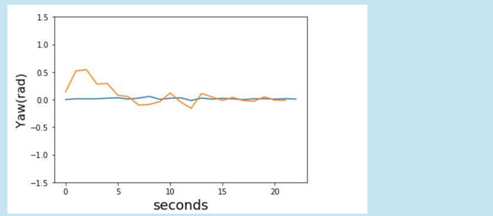
Approach

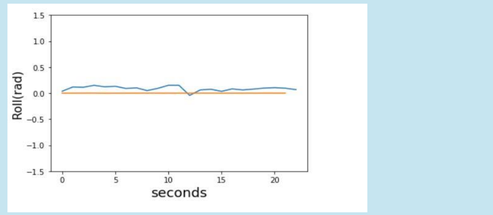


- Digital Video stabilization involves three stages: motion estimation, motion smoothing, and image composition. Due to our project involving camera motion estimation exclusively, we can perform the first stage of this process to achieve our goal.
- We find camera motion by tracking a few key points between two frames and estimating their differences. We can test the accuracy of the transform estimation by printing our matrix and comparing with test data.
- We starts by inputting a video and defining important aspects about the video, such as size and frame amount. It then retrieves the first frame image, assigns it to "previous frame", and creates a transformation matrix of zeros. This will become our baseline and allow us to determine how much the key points in the next frame have changed from their original position. After forming this baseline, the code begins a for loop that iterates through each frame and determines how the camera has changed.

Results







- As you can see this are the result we got. It is neither great nor bad because the application which we used to get the data was not good because it was giving random timed data. So, it is hard to compare. This is just to make you excited about the problem.
- From the visualization, we can say it is good with small shifting but performing bad when you are rotating too much.
- We also tried to smoothen our data using some different filter but result has not changed in our favor.

Summary & Next Steps

- So, It is very interesting topic of computer vision which is kind of forgotten after deep learning comes to the market but still we can achieve lots of interesting things using this localization and mapping techniques.
- We can implement this for objecting tracking, video stabilization , augment reality gaming etc. Some companies are working on using this for augment reality which we will come to the market very soon.
- As per our next step is to try to smooth our result using filter like Kalman filter, moving average filter etc. Also, try to estimate acceleration and aptitude of the drone. Which requires more of robotics touch with lots of sensor data .