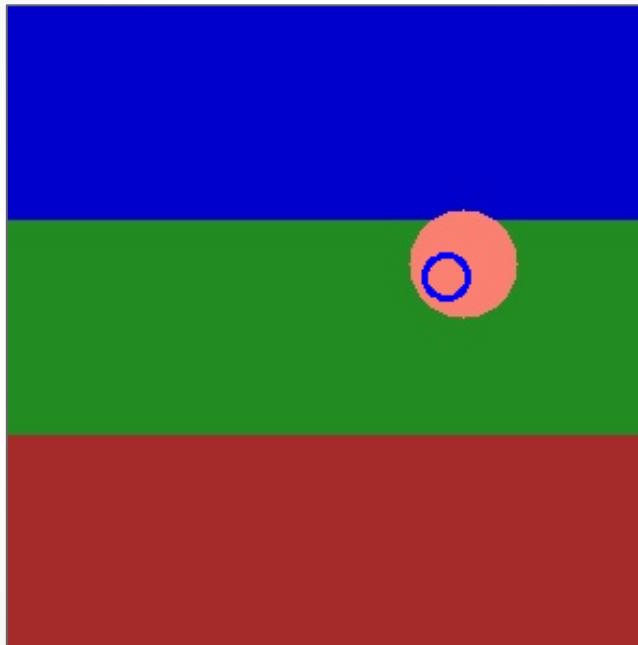
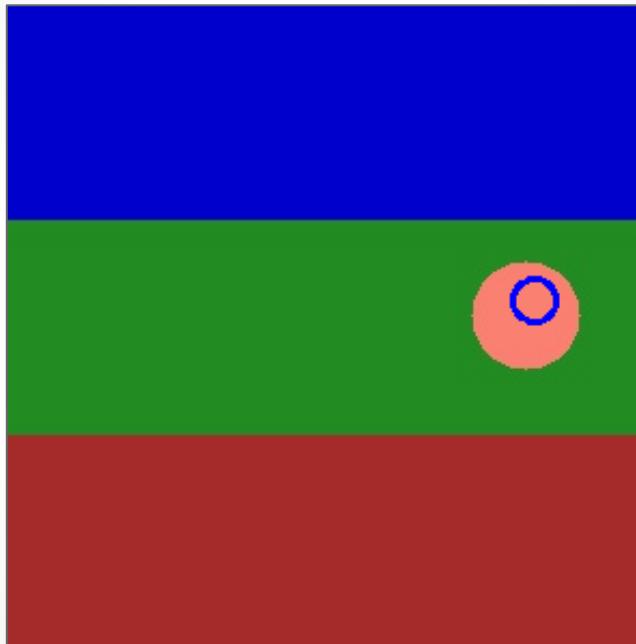


1b: KF Tracking a circle



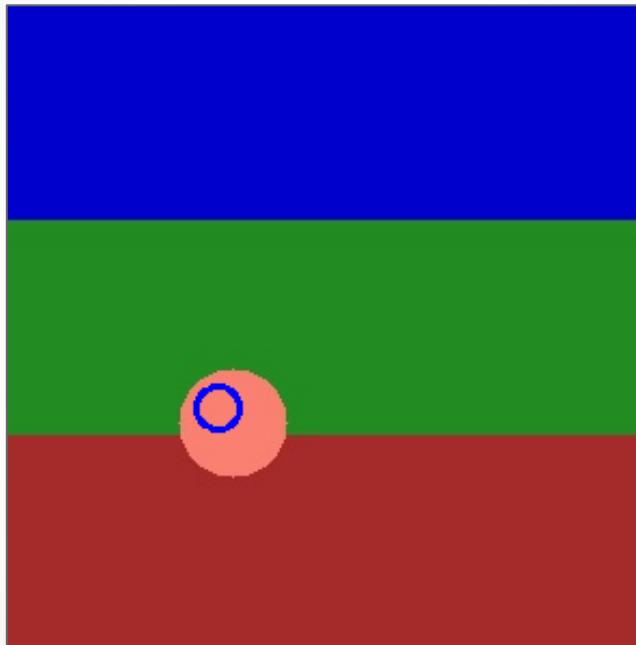
ps5-1-b-1.png

1b: KF Tracking a circle (cont.)



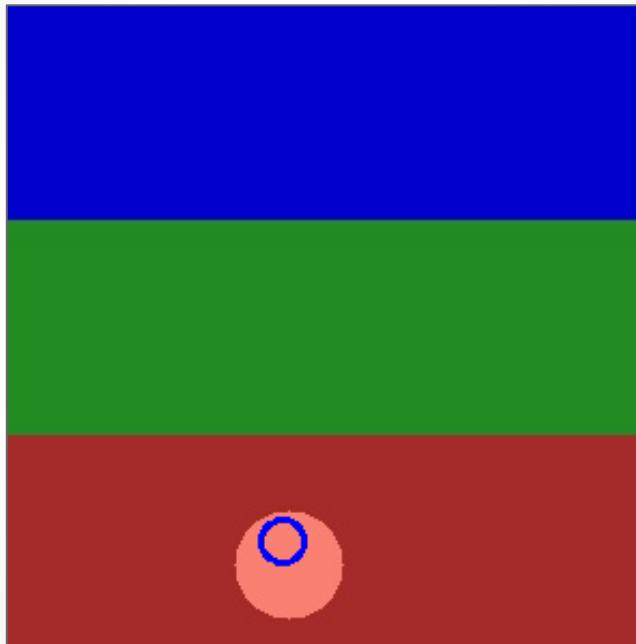
ps5-1-b-2.png

1b: KF Tracking a circle (cont.)



ps5-1-b-3.png

1b: KF Tracking a circle (cont.)



ps5-1-b-4.png

1c: KF Tracking pedestrians



ps5-1-c-1.png

1c: KF Tracking pedestrians



ps5-1-c-2.png

1c: KF Tracking pedestrians



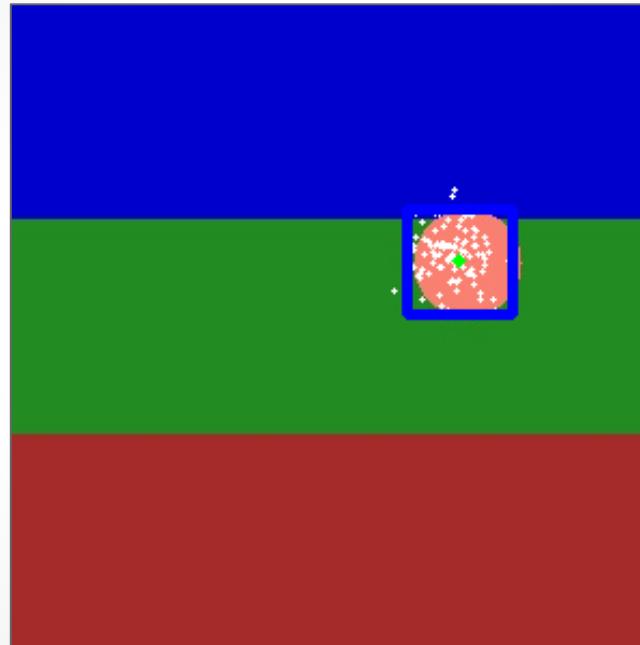
ps5-1-c-3.png

1c: KF Tracking pedestrians



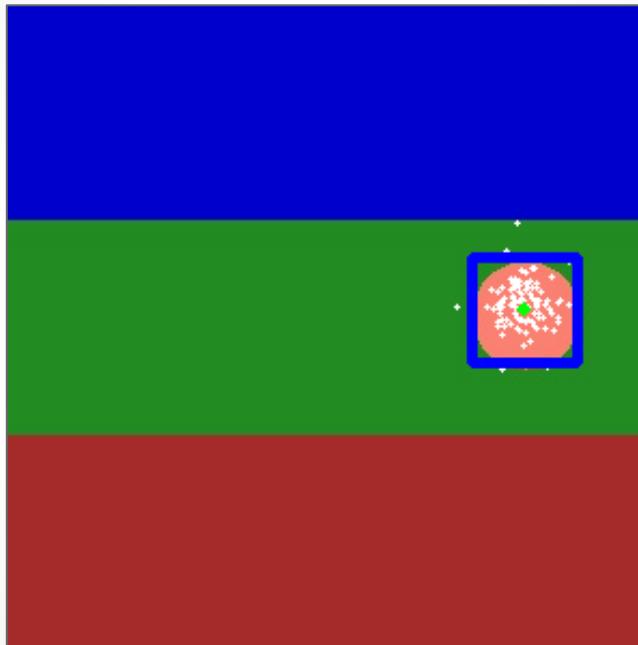
ps5-1-c-4.png

2a: PF Tracking a circle



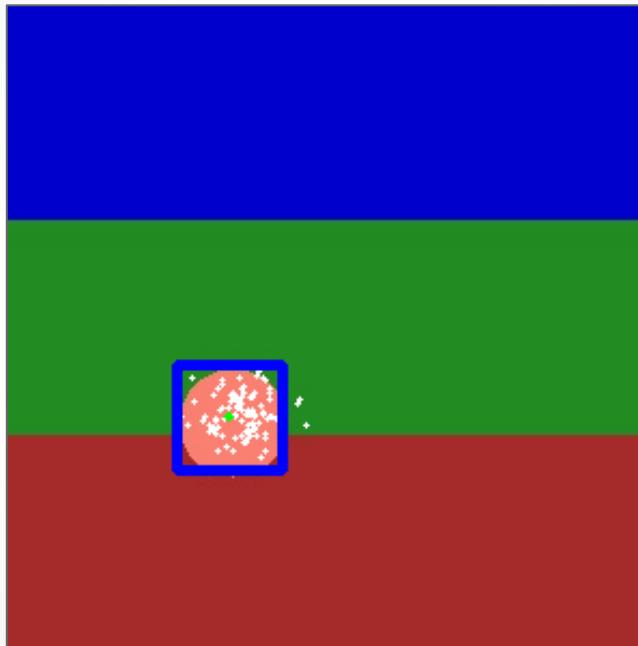
ps5-2-a-1.png

2a: PF Tracking a circle (cont.)



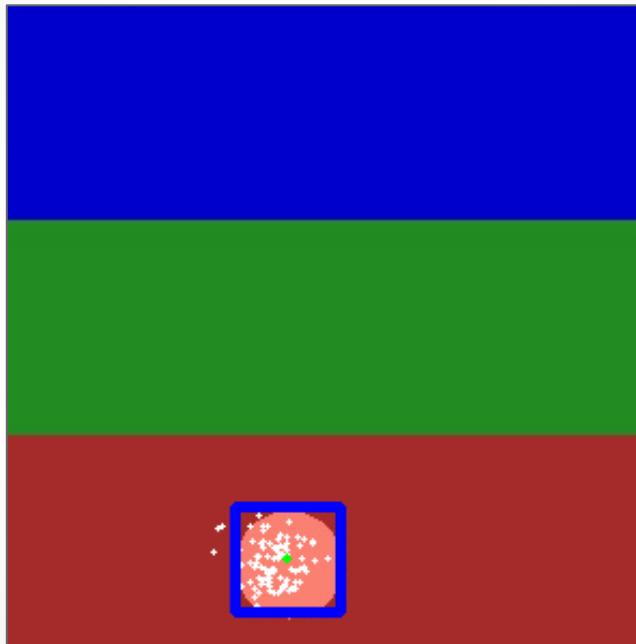
ps5-2-a-2.png

2a: PF Tracking a circle (cont.)



ps5-2-a-3.png

2a: PF Tracking a circle (cont.)



ps5-2-a-4.png

2b: PF Tracking noisy video



ps5-2-b-1.png

2b: PF Tracking noisy video (cont.)



ps5-2-b-2.png

2b: PF Tracking noisy video (cont.)



ps5-2-b-3.png

2b: PF Tracking noisy video (cont.)



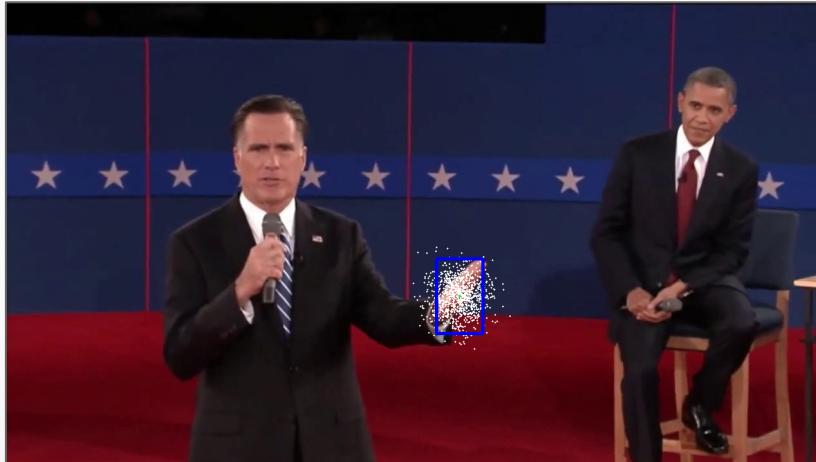
ps5-2-b-4.png

3a: PF Changes in Appearance



ps5-3-a-1.png

3a: PF Changes in Appearance (cont.)



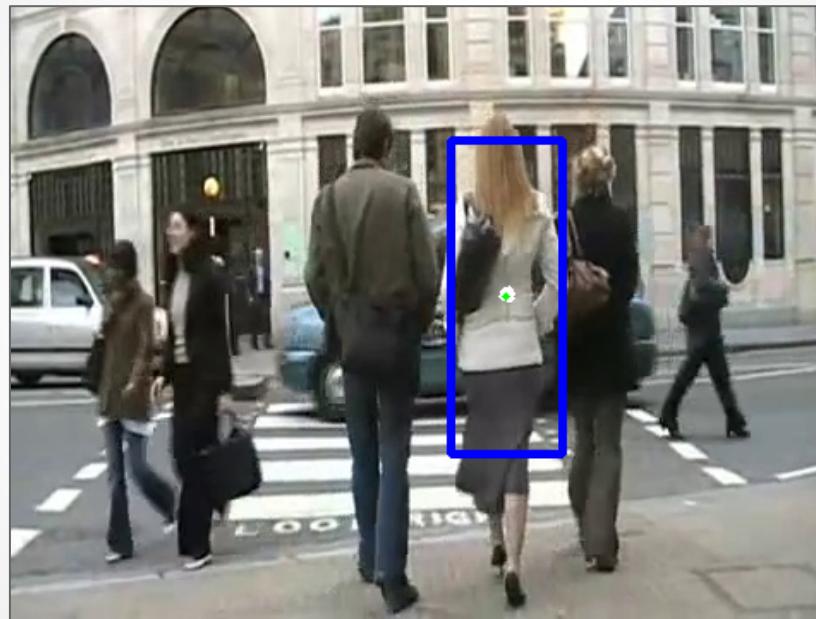
ps5-3-a-2.png

3a: PF Changes in Appearance (cont.)



ps5-3-a-3.png

4a: PF Occlusions



ps5-4-a-1.png

4a: PF Occlusions (cont.)



ps5-4-a-2.png

4a: PF Occlusions (cont.)



ps5-4-a-3.png

4a: PF Occlusions (cont.)



ps5-4-a-4.png

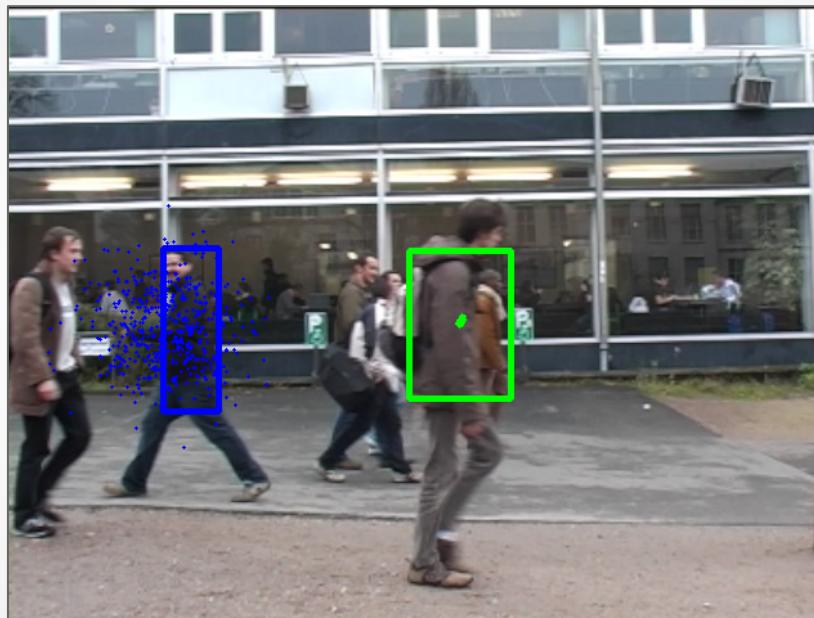
4: Text response

Firstly, I had to adapt template for each frame. As woman walks away, template should also have the ability to scale down. For that I've added another parameter to particles' state - scale, that defines how much template should be scaled. Rendered output shows template window with weighted sum of all particle window sizes.

Secondly, I lowered sigma value for particle movements, so that when occlusion happens particles don't scatter away too much. But this approach works only when object hasn't moved too far away along X or Y axis.

Another approach would be to redistribute particles across the whole image if template matching shows poor results. That way, when object reappear at least some particles can find it again and new particles can be resampled from those.

5: Tracking multiple targets



ps5-5-a-1.png

5: Tracking multiple targets (cont.)



ps5-5-a-2.png

5: Tracking multiple targets (cont.)



ps5-5-a-3.png

5: Text response

What I did:

- 1) Introduced horizontal velocity as another parameter to particle state. That way objects can be tracked even when they're occluded by another object, as long as they move at near constant speed;
- 2) To track multiple objects I created separate filter for each object. Each filter can also be tuned for specific target (including frame when object tracking should begin). Since filters work independently I didn't have to add any special changes to filters themselves.
- 3) Chose template for each target. Man in black was the easiest one to track even though he was occluded several times. Other two people on the other hand were wearing brown jackets which are similar in color to the background (bushes, road). So to track other two I chose parts that don't change much and have unique color - their backpack and shoulder area.

Kalman filter vs Particle filter:

I tried tracking people with Kalman filter, but faced a lot of difficulties that caused target point to lose its target. What I found out is that you have to add velocity to transition matrix and pick good template. The last part was especially difficult to tune. Particle filter on the other hand was slower but much more robust, since even if a few particles wander off, others will compensate for that in numbers.