Visual Object Tracking using Color Representation

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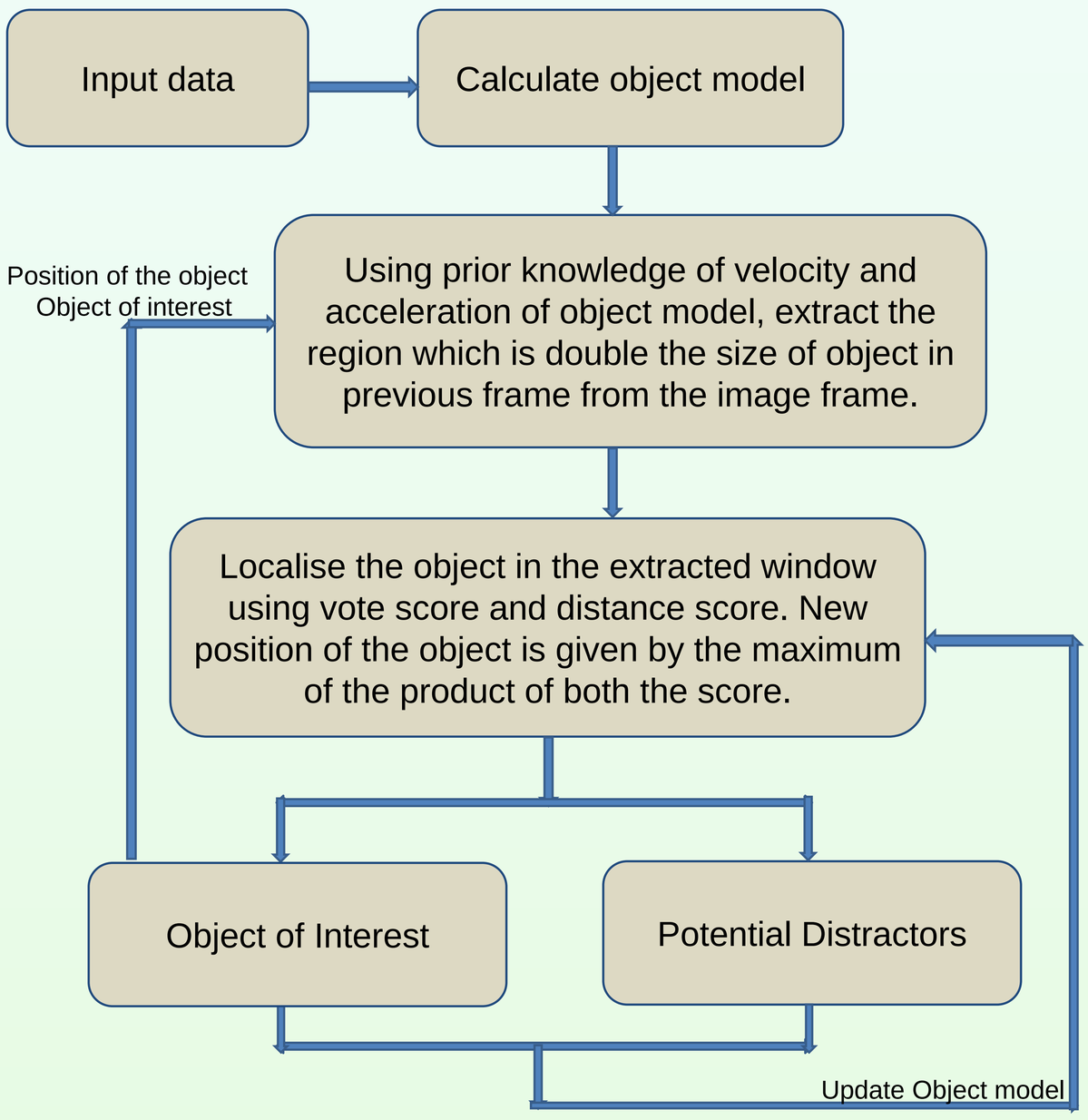
Introduction

We address the problem of online object tracking based on color representations. According to the findings of recent benchmark evaluations, such trackers often tend to drift towards regions which exhibit a similar appearance compared to the object of interest. To overcome this limitation, we used an efficient object model which allows us to identify potentially distracting regions in advance and suppress them in later stages.

Schematics



Working Principle

A color histogram based Bayes classifier is employed on the input image *Img* for differentiating object pixel $x \in Object$ from background pixel. Let b^{th} bin of the histogram h on the region $\varphi \in Img$ be shown as $h^{img}_{\varphi}(b)$. Color component $Img(y)$ be assigned a bin b which is denoted by b_y. let Θ be object region and *Surr* be its surrounding region, Bayes rules applied to get the object likelihood at position x as:

$$P(x \in object|\Theta, Surr, b_x) = \frac{P(b_x|x \in \Theta)P(x \in \Theta)}{\sum_{\varphi\epsilon\{\Theta,Surr\}} P(b_x|x \in \varphi)P(x \in \varphi)}$$

Likelihood terms can be directly estimated from the color histogram by:

$$P(b_x|x \in \Theta) \approx h_{\Theta}^{img}(b_x)/|\Theta|$$

$$P(b_x|x \in Surr) \approx h_{Surr}^{img}(b_x)/|Surr|$$

Object likelihood can be defined by:

$$P(x \in object|\Theta, Surr, b_x) = \begin{cases} \dfrac{h_{\Theta}^{img}(b_x)}{h_{\Theta}^{img}(b_x) + h_{\mathrm{Surr}}^{img}(b_x)} & if\ I(x) \in I(\Theta \cup \mathrm{Surr}) \\ 0.5 \end{cases}$$

Distractor model can be defined as:

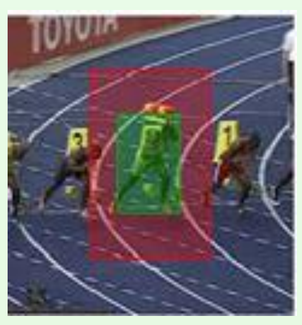
$$P(x \in object|\Theta, Dist, b_x) = \begin{cases} \dfrac{h_{\Theta}^{img}(b_x)}{h_{\Theta}^{img}(b_x) + h_{\mathrm{Dist}}^{img}(b_x)} & if\ I(x) \in I(\Theta \cup Dist) \\ 0.5 \end{cases}$$

- Object model is continuously needed to be updated to deal with the continuously changing object appearance and to retain important features that is contant for the object hence object model will be updated as:

$$P_{1:t}(x \in object|b_x) = \eta P(x \in object|b_x) + (1-\eta)P_{1:t-1}(x \in object|b_x)$$

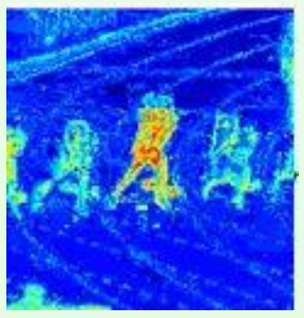
Object model is defined by:

$$P(x \in object|b_x) = \lambda_p P(x \in object|\Theta, Dist, b_x) + (1-\lambda_p)\, P(x \in object|\Theta, Surr, b_x)$$



Object Model

Distractor Model



Combined Model

References

1) H Possegger, T Mauthner and H Bischof, “In defense of color-based model-free tracking”, 2015 IEEE CVPR.
2) A Yilmaz, O Javed and M Shah, “Object tracking: A survey”, ACM computing surveys (CSUR), 2006.