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Reactive Gaze During Locomotion in Natural Enviroments

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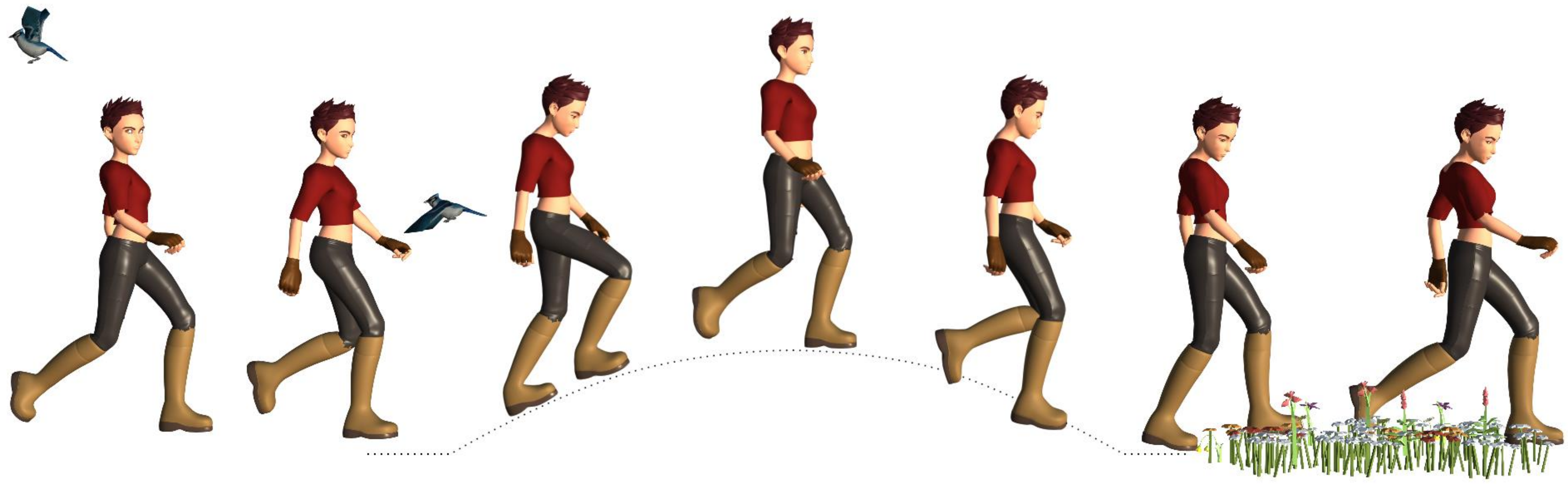
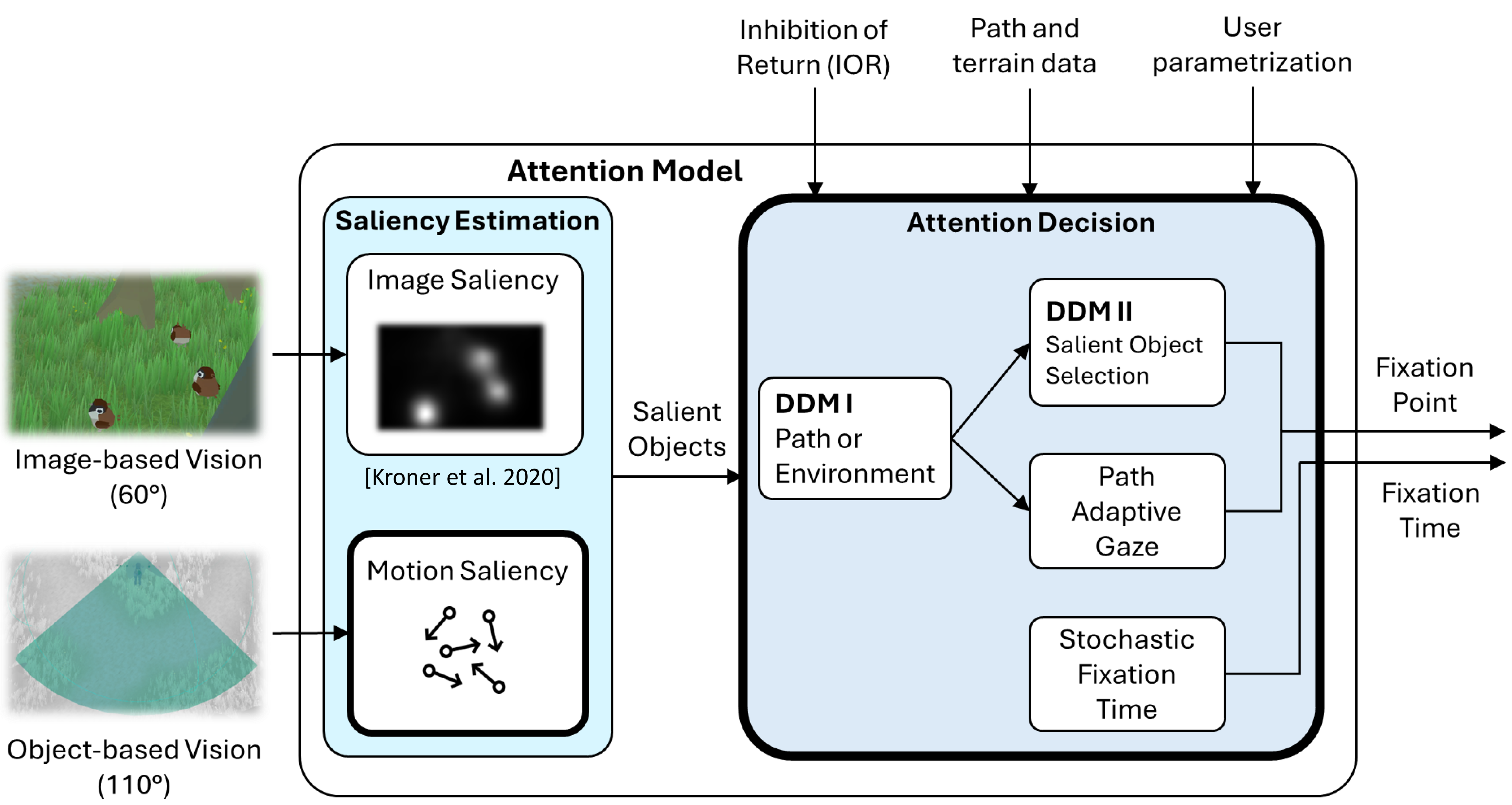


Our visual attention model considers the character's path, the slope of the terrain, and the salience of shapes and motion of surrounding elements.

OVERVIEW



MOTION-AWARE SALIENCY ESTIMATION

We expand upon a previous perceptual study [Arpa et al. 2011]

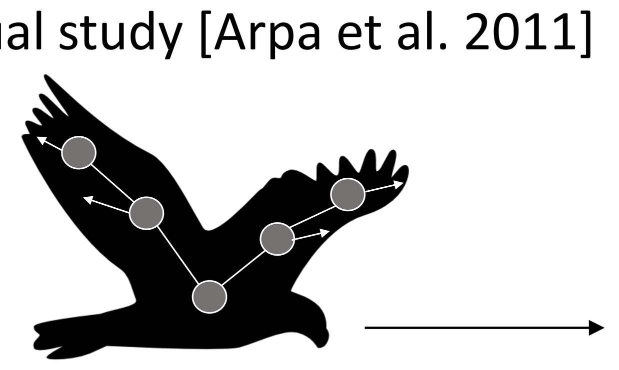
Motion Types:

- Appearance
- Onset
- Change

} 1.0

- Offset
- Continuous

} 0.2



- Calculate apparent velocity and acceleration $\boldsymbol{v}_j^a(t)$, $\boldsymbol{a}_j^a(t)$
- Give each joint a motion saliency score $m_j(t)$
- Perceptual speed:

$$V_j(t) = m_j(t)\ (\|\boldsymbol{v}^{a_j}(t)\| + \|\boldsymbol{v}^{a_j}(t-\Delta t)\|)/2$$

- Final motion saliency score of the object:

$$\begin{cases} M_i(t) = m_{j_{\max}}(t) \\ \text{where } j_{\max} = \underset{j\in[\![0,N_{joint}-1]\!]}{\operatorname{argmax}} \ V_j(t) \end{cases}$$

ATTENTION DECISION SYSYEM

I. The agent chooses between looking at the path or at the environment

$$\mu^{p/e}(t) = \alpha(t)\ \delta t_{\text{path}}(t) - \frac{1}{N_s}\sum_{i=0}^{N_{\text{salient}}} \hat{S}_i(t) + b$$

$\alpha(t)$: Current terrain slope; $\delta t_{\text{path}}(t)$: Time since last path look; $\frac{1}{N_s}\sum \hat{S}_i(t)$: Average object saliency (with IOR); b: Behavioral bias

IIa. The agent chooses to look at an object

$$\mu_i^{salient}(t) = S_i(t) + \omega_i(t)$$

$S_i(t)$: Object Saliency Score; $\omega_i(t)$: Inhibition of Return (IOR)

IIb. The agent chooses to look at the path

$$d = d_{\max} - \frac{\alpha}{\alpha_{\max}}(d_{\max} - d_{\min})$$

RESULTS

- Implemented with C# in Unity 3D and Python
- Main overhead is communication between Unity and Python
- Interactive with user input (60 FPS)
- Two navigation modes (user input and pre-defined trajectory)

FINAL CONSIDERATIONS

Limitations

- Motion saliency relies on geometric vision
- DDM processes need to be changed to account for more factors

Future Work

- Use of optical flow for an image-based motion saliency estimation
- Coupling attention model with a full-body animation system

ACKNOWLEDGEMENTS

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