Real-Time Approximation of Convincing Spider Behaviour

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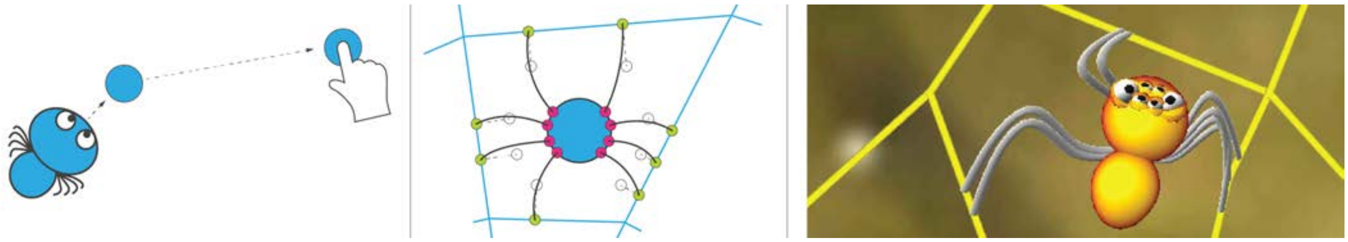

Figure 1. *Modeling realistic spider motions and animations, aiming for the integration in multiplayer mobile games. An intermediate point is moving to the destination to abstract movement from an underlying web (left), the position of the spider's leg is determined on the nearby web (center), and the implementation of the algorithm in the mobile game Weaver (right).*

1 Introduction

Convincing and natural motions and animations of animal behaviour are widely used in computer animated movies and video games. Cenydd (2013) provides a survey of arthropod animation algorithms, but does not include spider movements on predefined paths like strands of a web, which is – as far as we know – not covered by current research. Aiming at integrating animated spiders and web weaving in mobile video games, we suggest an algorithm to model spiders moving to a user-defined destination. The path is constrained by an underlying web, which is created by the user and optimized by verlet integration for a sufficiently realistic representation. All introduced methods can be computed in real-time, even on less powerful devices.

2 Approach

Our proposed algorithm is twofold: (1) user-driven change of the spider position and (2) convincing motion of the spider and its legs on the spider web.

2.1 User-driven change of spider position

Based on the game design, the user controls spiders by touching at the intended destination on the screen. An intermediate target directly moves to the selected position with a decreasing velocity as it gets closer to the destination (see Figure 1, left). If no further user input occurs until the animation ends, the intermediate target and the destination are at the same position.

2.2 Positioning the spider on its web

Based on the intermediate target of the previous step, we need to determine the position of both body and legs of the spider. Therefore, we use a prototypical spider with spatial dimensions and place it at the intermediate target from step 2.1. For each of the eight spider legs the closest point on a strand is determined. The arithmetic average of these eight points is used as the new position for the spider. A second pass is started from this new position – for each spider leg, the closest point on the strands is again determined and the spider is placed at the arithmetic average of these new connection points. The actual leg movement is carefully timed (legs move at different points in time) to create the impression of 8-legged walking.

3 Results & Conclusion

Our approach creates a convincing behaviour of spiders walking over their webs, even with low computational power. This enables us to use the algorithm on mobile devices and in real-time to provide an excellent user experience and user engagement. The twofold algorithm eases the game logic by separating the position handling from the structure of the underlying web. Additionally, the 2-pass approach covers common edge cases: (1) If two objects are connected by only one strand and the intermediate target is close to this strand, the spider will be centered on it. The animation shows a spider walking directly on the web. (2) If the spider point moves from one strand to a far away strand and these two strands are not connected, a jumping motion is experienced as spider and leg positions change. (3) If the intermediate target is in the middle of two strands far apart from each other, the legs are (in most cases) assigned to only one strand, and the spider stays – due to the two passes – on this strand.

The algorithm uses multiple passes, since one pass alone yields an unrealistic movement path and leg stretching. More than two passes would be conceivable, however, we observed sufficiently good results while maintaining real-time speed on mobile devices with two passes. Due to the sufficiently realistic behaviour and real-time capability, the algorithm is integrated in Weaver[1] – a mobile game where multiple players together control spiders, build webs and catch insects on a tablet device.

References

CENYDD, L. A., & TEAHAN, B. (2013). An embodied approach to arthropod animation. Computer Animation and Virtual Worlds, 24 (1), 65-83.

MILLINGTON, I., & FUNGE, J. (2009). Artificial intelligence for games. CRC Press.

[1] http://prefrontalcortex.de/weaver

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