# Emotionally Expressive Motion Controller for Virtual Character Locomotion Animations

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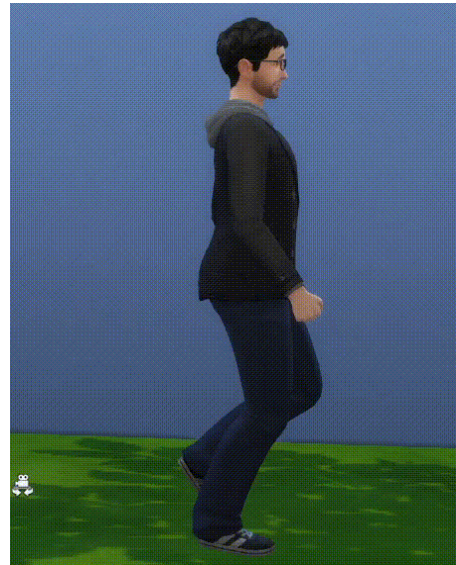
# MOTIVATION



"Neutral"

[The Sims 4, Maxis, 2014]

"Angry"

"Confident"
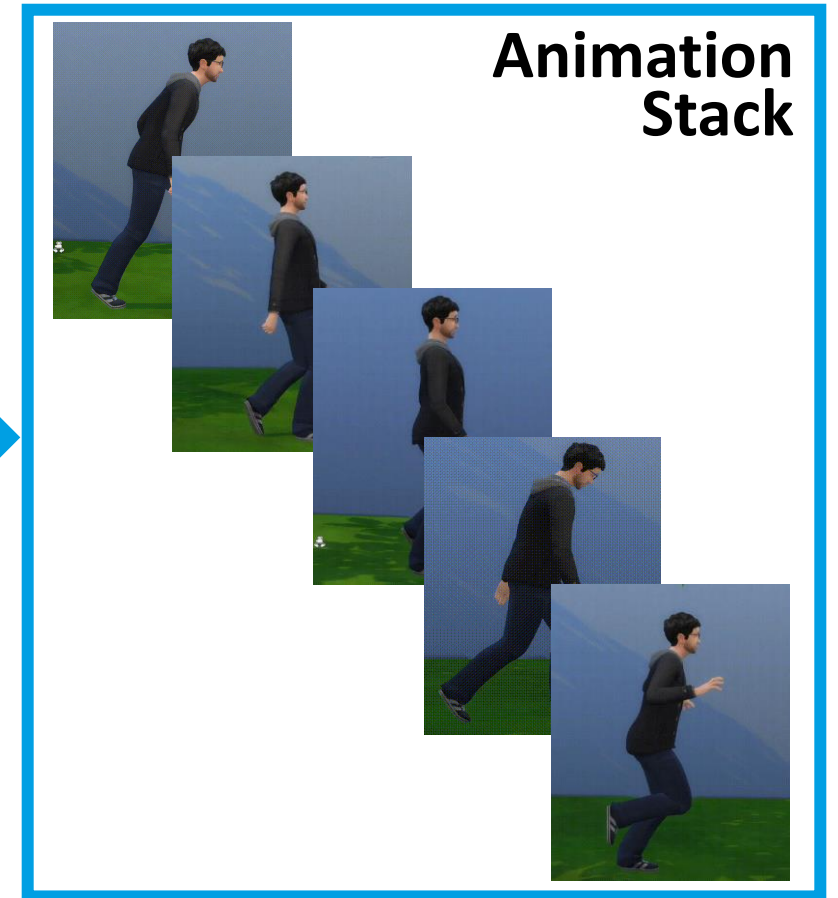
"Energized"

"Sad"

"Afraid"

# PROBLEM

- New Animation for each Emotion

- Variants of Baseline

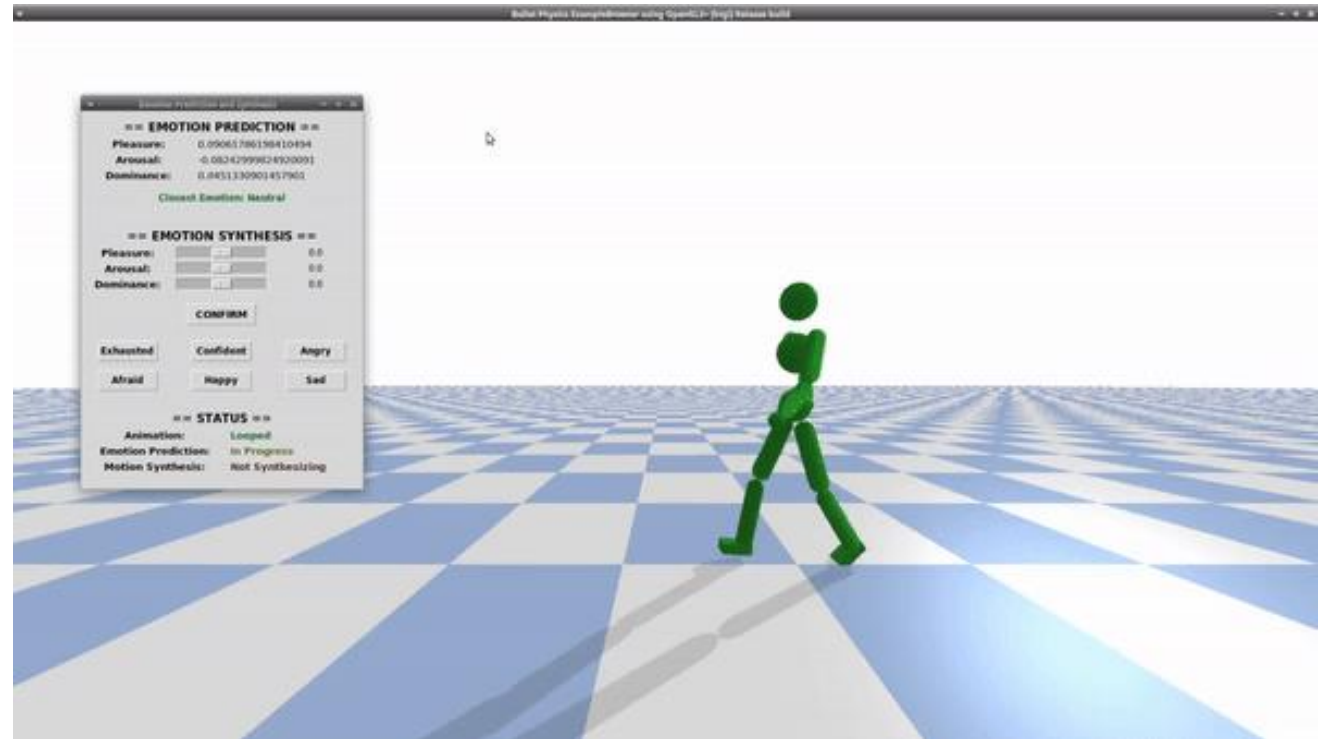- Repeat Process for each Motion

- Time Consuming & Expensive



[The Sims 4, Maxis, 2014]

**Animation Stack**

# SOLUTION

- Real-Time Emotion Identification & Synthesis

- Focused on Locomotion

- Emotions described using the PAD Emotional Model

- Works with both Kinematic & Policy-Based Physics-Enabled characters

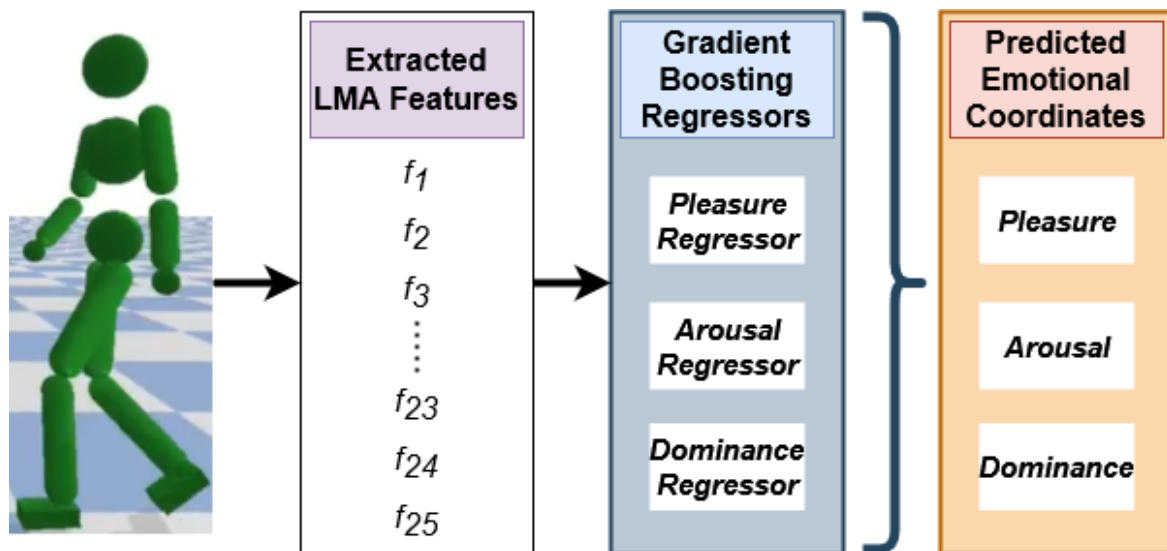- Based on Machine Learning & Laban Movement Analysis



**Emotionally Expressive Motion Controller**

# EMOTIONALLY EXPRESSIVE MOTION CONTROLLER
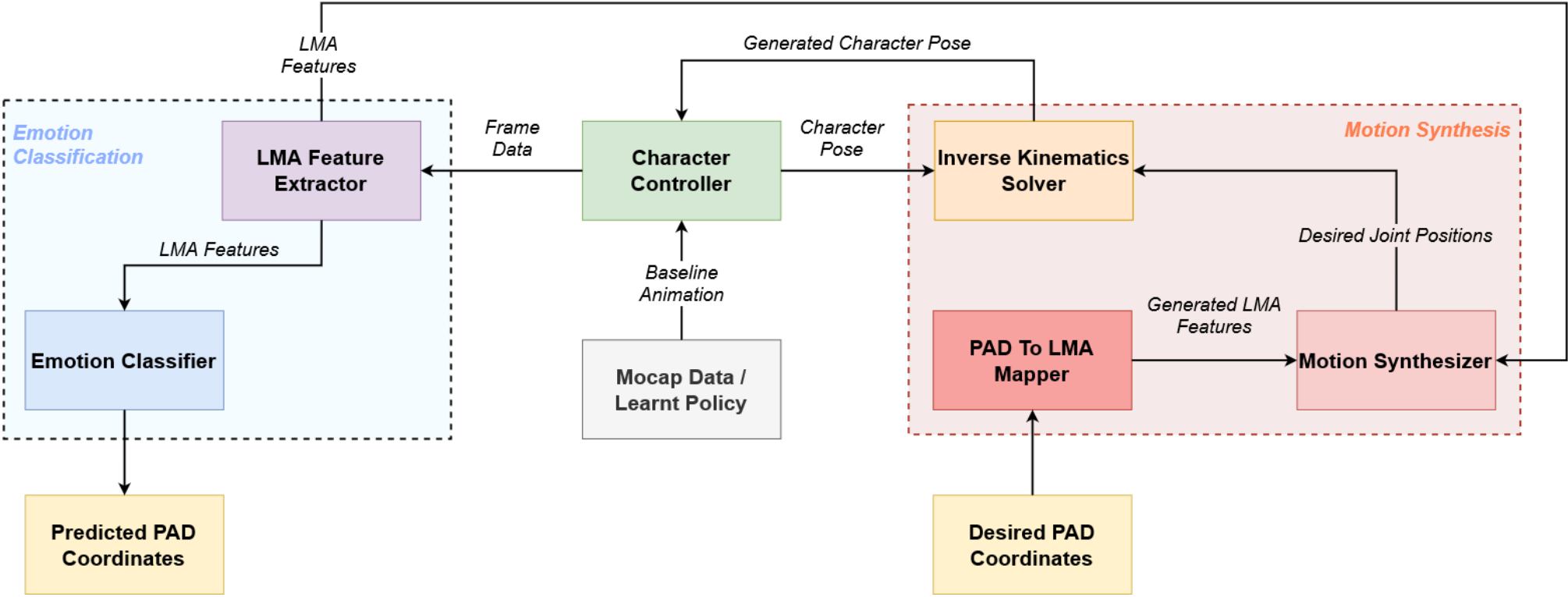
# EMOTIONAL Identification



| LMA Feature | $f$ | LMA Category |
|---|---|---|
| Max Hand Distance | $f_1$ | Body |
| Avg. Left Hand - Hip Distance | $f_2$ | Body |
| Avg. Right Hand - Hip Distance | $f_3$ | Body |
| Max Stride Length | $f_4$ | Body |
| Avg. Left Hand - Chest Distance | $f_5$ | Body |
| Avg. Right Hand - Chest Distance | $f_6$ | Body |
| Avg. Left Elbow - Hip Distance | $f_7$ | Body |
| Avg. Right Elbow - Hip Distance | $f_8$ | Body |
| Avg. Chest - Pelvis Distance | $f_9$ | Body |
| Avg. Neck - Chest Distance | $f_{10}$ | Body |
| Avg. Total Body Volume | $f_{11}$ | Shape |
| Avg. Lower Body Volume | $f_{12}$ | Shape |
| Avg. Upper Body Volume | $f_{13}$ | Shape |
| Avg. Area between Hands and Neck | $f_{14}$ | Shape |
| Avg. Area between Feet and Hip | $f_{15}$ | Shape |

| LMA Feature | $f$ | LMA Category |
|---|---|---|
| Left Hand Speed | $f_{16}$ | Effort |
| Right Hand Speed | $f_{17}$ | Effort |
| Left Foot Speed | $f_{18}$ | Effort |
| Right Foot Speed | $f_{19}$ | Effort |
| Neck Speed | $f_{20}$ | Effort |
| Left Hand Acceleration Magnitude | $f_{21}$ | Effort |
| Right Hand Acceleration Magnitude | $f_{22}$ | Effort |
| Left Foot Acceleration Magnitude | $f_{23}$ | Effort |
| Right Foot Acceleration Magnitude | $f_{24}$ | Effort |
| Neck Acceleration Magnitude | $f_{25}$ | Effort |
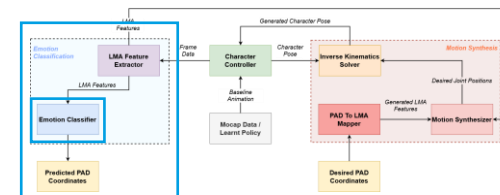
# MOTION SYNTHESIS
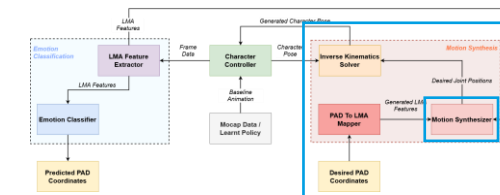
- Generate new set of LMA Features

- Compute new desired positions/rotations for core joints

- 6 Heuristic Rules

- Coefficients to represent the difference between Baseline's and Generated LMA Features
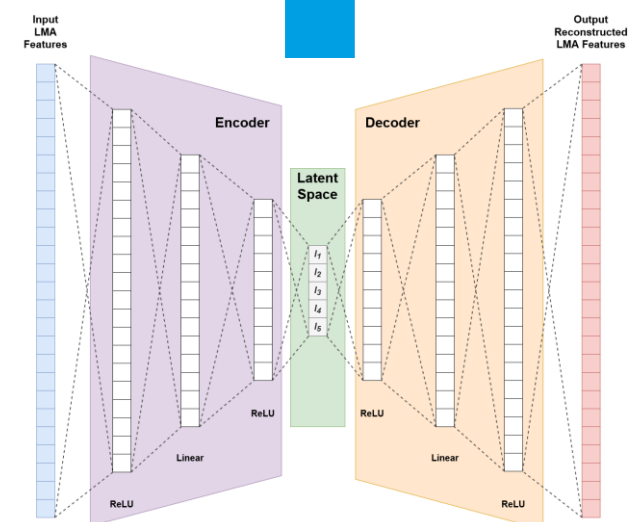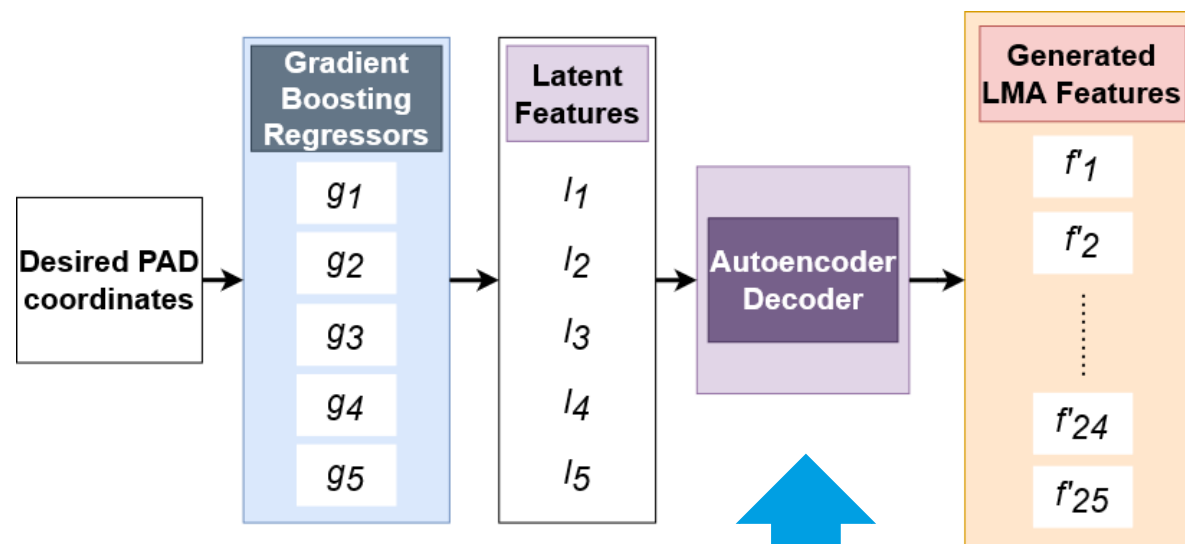
$$\sum_t \| \hat{f} - f_t c \|^2$$

# MOTION SYNTHESIS
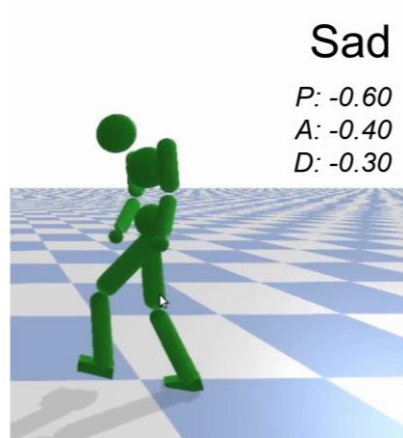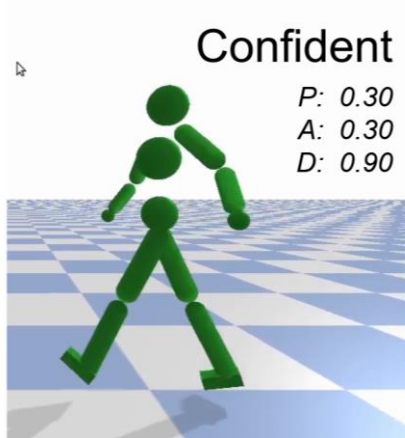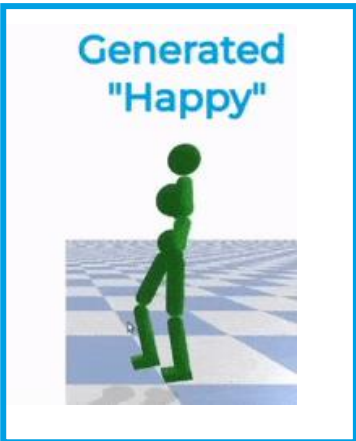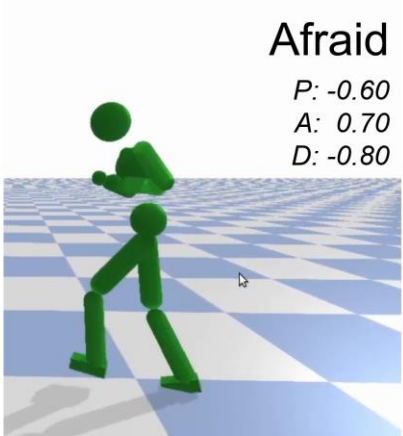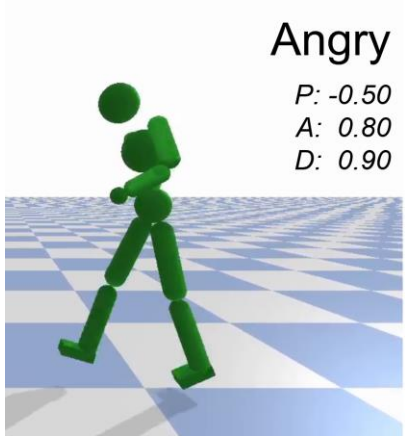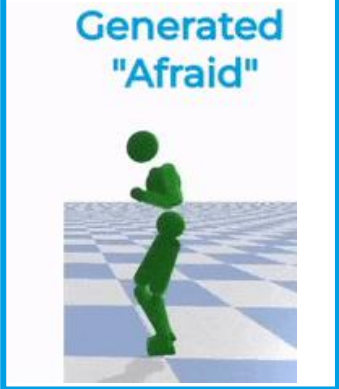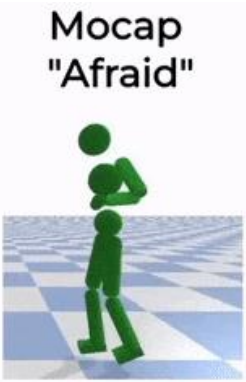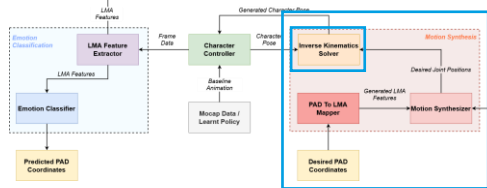
# CONCLUSION

- Automatic System for **Emotionally Expressive Motion Synthesis** of Locomotion Animations

- Works with both **Kinematic** and **Policy-Based** Physics-Enabled Character **Controllers**

- Emotions specified using the **PAD Model**

- **Emotional Prediction** and **Motion Synthesis** in **Real Time**

- Quality of synthesized motions validated through **User Tests**
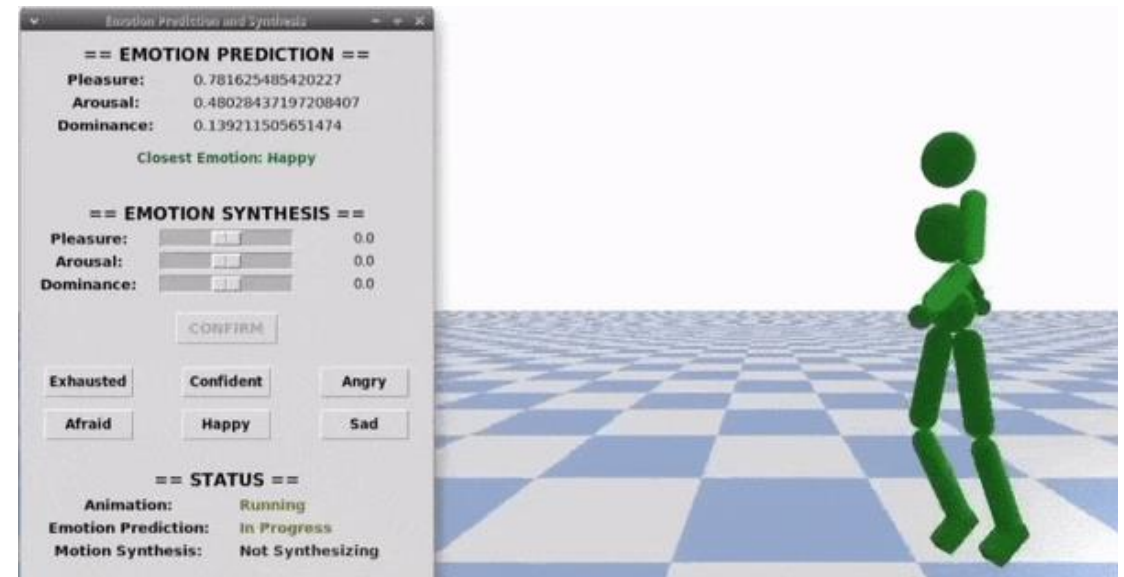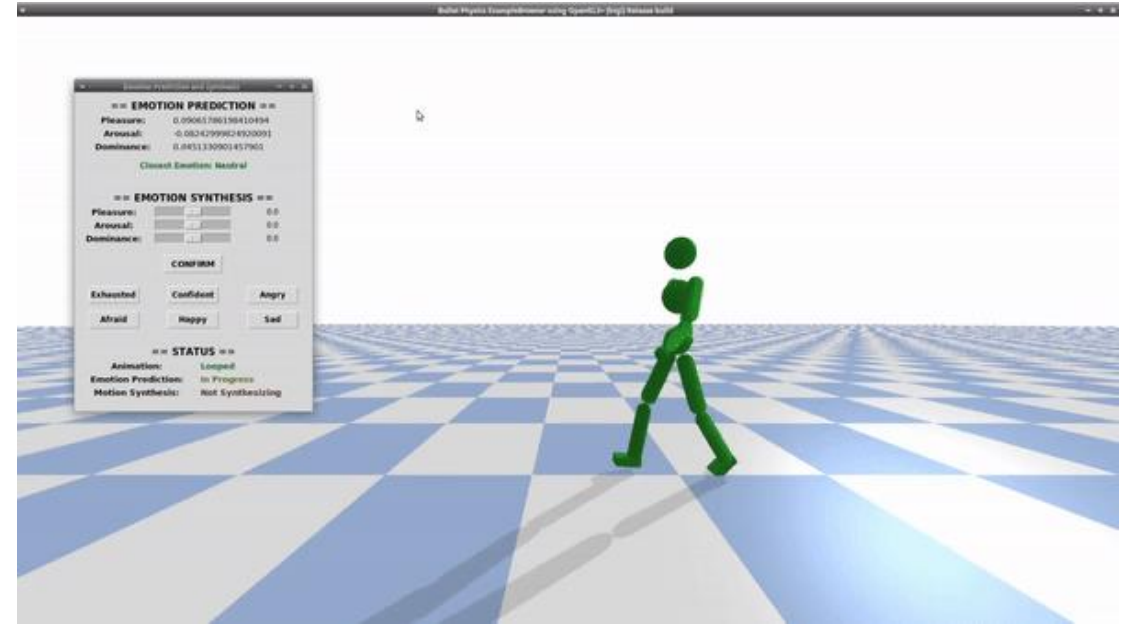
# Thank you for listening!

More Info at: https://heroufenix.github.io/expressive_animations_web/